



CARNIVOROUS PLANTS

GARDENING WITH
EXTRAORDINARY
BOTANICALS

NIGEL HEWITT-COOPER



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CARNIVOROUS PLANTS



► NIGEL HEWITT-COOPER ◀

CARNIVOROUS



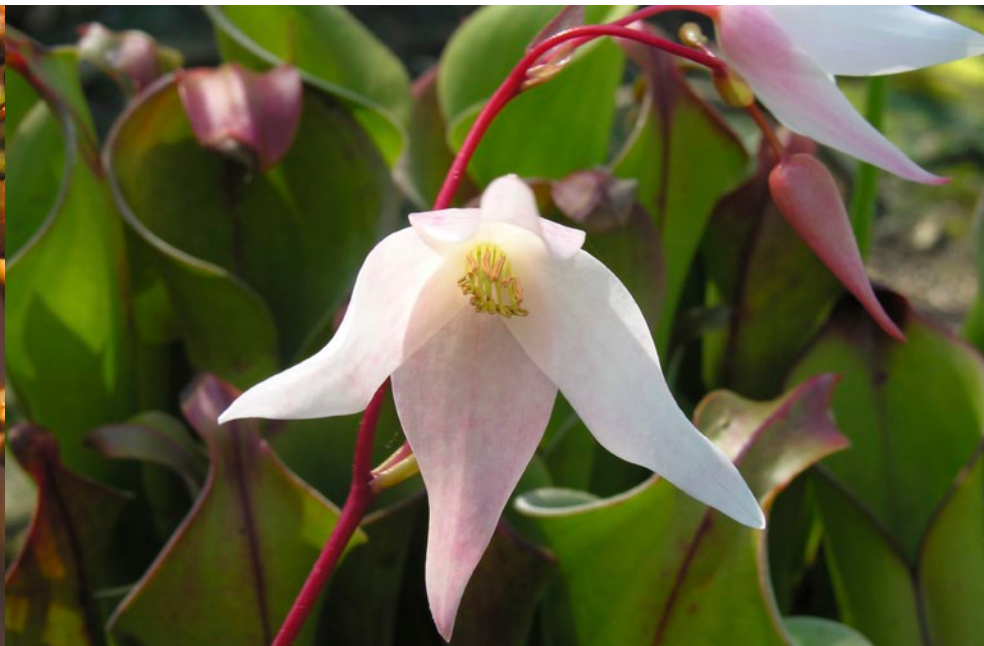


PLANTS

Gardening with
Extraordinary Botanicals

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Frontispiece: (clockwise from top left) *Cephalotus follicularis*, *Darlingtonia californica*, *Sarracenia flava* var. *cuprea*, *Heliamphora nutans*, *Nepenthes rajah*, *Dionaea muscipula*.

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To my family, who have tolerated my botanical madness for the past three decades—especially my wife Polly and my three children, Tom, Lily, and Daisy. And to Uncle Jim, who bought me that first Venus flytrap in 1981.





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INTRODUCTION

**“Nigel, It is obvious
you share my pas-
sion and knowledge
of the species. Long
may you continue to
do so.”**

—ADRIAN SLACK

This brief message came to me
as this book was in production.
I have made the acquaintance
of Mr. Slack, and the fact that
he considers my passion and
knowledge of these species to

be in the same realm as his is deeply gratifying. He is without doubt the preeminent name in the modern-day cultivation of carnivorous plants. His books fueled my early interest; in fact, his *Insect-Eating Plants and How to Grow Them* was the last book written by an Englishman on carnivorous plant cultivation, some thirty years ago.

My interest in the botanical world (today I admit to a straight-up obsession) came at an early age. I grew up in the once-leafy London suburbs, where my grandmother, who lived locally, was one of those people who could grow virtually anything with a good degree of success. She had a small wood-framed greenhouse in her garden which was barely six feet (two metres) square. As a child, I would delight in accompanying her there to water the occupants within.

Even at that young stage, I found the incredible variation of form and colour fascinating, and as I looked upward through the green canopy in this tiny Eden, I recall being awestruck by the beauty of the diversity.

When I was seven, an uncle bought me my first Venus flytrap. At that time, such plants (almost certainly ripped from the wild, unfortunately) could be found in garden centres, protected under unnecessary plastic domes—further prompting the curiosity of my seven-year-old mind. This poor specimen, like millions of its brethren, was doomed to die. But for me, it was an introduction to a group of plants which was to become a fascination that has captivated and at times frustrated me for thirty-five years. The largest obstacle to overcome in the early 1980s was the lack of information available on the subject. Aside from a handful of dedicated fanatics, carnivorous plants were generally unknown to the wider public; even now there are many who could not name an example besides the ubiquitous flytrap.

Back then, Adrian Slack's groundbreaking *Carnivorous Plants*, published in 1979, was the only English-language book on the subject that was up to date. This title not only (though predominantly) covered the taxonomic nuances of these plants, but also for the first time touched, albeit briefly, on cultivation.

Only a year earlier, the UK's Carnivorous Plant Society had been formed, its aim to bring together like-minded individuals who had been bitten by the bug, so to speak. Through the organization's journals and newsletters one could read of other enthusiasts' successes and failures, the latter of which were common for us all.



Dionaea muscipula
'Sawtooth'.

The paucity of information and available plant material meant that a grower's primary goal was to maintain plants in cultivation. Any experiment that might result in a loss was out of the question, and the suggestion that temperate species could be grown outside was the furthest thing from our minds.

Slack followed up his first book with *Insect-Eating Plants and How to Grow Them* in 1986. As suggested in the title, the book's focus was cultivation; it brought together early successes and served to introduce the hobby to a wider audience. My own collection grew as quickly as it could with the limited number of plants available, and I had my own personal triumphs and disasters, at times in equal measure. But the interest remained resolute.

By the early '90s there were a number of books, both botanical and with an emphasis on cultivation, written by authors around the world. The number of species in cultivation

increased exponentially as more people became hooked on the diversity and beauty of such unusual plants. This growth, combined with the advent of the Internet and the ease with which information can be shared, has meant an explosion of knowledge over the past fifteen years. The combined work and travel of a comparatively small number of intrepid adventurers has also resulted in a large number of new species being described since 2000.

It seems there remains a gap in the market, however—a lack of information in print as to the general cultivation of carnivorous plants. I still hear this from people, as well as the problem that the huge amount of information available online is bewildering and often contradictory.

The purpose of this book is to act as both a general introduction to the genre of carnivorous plants, and as a guide for the more advanced grower who may have had a few successes and wishes to delve deeper into this peculiar and somewhat alien world. Cultivation is the primary intent, and I will cover the more commonly and easily grown representatives of a number of different genera, relying on plants that can successfully be grown in the home and garden.

There are a number of myths and misconceptions that surround carnivorous plants, in fact probably more than any other horticultural grouping, which does little to endear them to potential growers. I hope to dispel many of these erroneous assumptions.

To many, the mention of carnivorous plants evokes images of hot, tropical conditions. There are species that thrive in such environments, but most that you are likely to encounter and grow successfully are in fact temperate.

Though few people contemplate growing these plants in the confines of an average house, let alone cultivating them outside, I want to challenge such views and attitudes. Some dismiss carnivorous plants as novelties; many pass my displays at flower shows, declaring, “Oh, I don’t like those things.” When introduced to the intrinsic beauty and wide-ranging diversity of these plants, however, I find that most people can appreciate their grace and elegance.

I will also challenge the outdated opinion that carnivorous plants are strictly greenhouse inhabitants. Indeed, a good many are candidates for the garden, and hence deserving of a place alongside today’s favourite ornamental plants.



CARNIVOROUS PLANT BASICS

The stocky
pitcher of
Nepenthes mira.

Man has been aware of carnivorous plants for centuries, though their feeding habits weren't categorically confirmed until Charles Darwin wrote *Insectivorous Plants*,

published in 1875. In Henry Lyte's *New Herball* of 1578, the widespread sundew species *Drosera rotundifolia* is pictured and described, albeit somewhat erroneously in the chapter describing mosses, despite the recognition of it possessing white flowers.

This herb is of a very strange nature and marvellous: for although that the sun does shine hot, and a long time thereon, yet you shall find it always moist and bedewed, and the hairs thereof always full of little drops of water: and the hotter the sun shineth upon this herb, so much the moistier it is and the more bedewed, and for that cause it was called *Ros Solis* in Latin, which is to say in English, The Dew of the Sun, or Sun Dew.

A charming description of what was recognized then as a somewhat unusual plant—but no mention of its carnivorous habit, nor any clue that Lyte noticed a presence of insects caught on the leaves in his observation of the plant.

Early references to *Sarracenia* also do not take into account the genus's potential carnivorous habit. The botanist Mark Catesby in his *Natural History of Carolina, Florida, and the Bahama Islands*, published in 1754, illustrates both *S. flava* and *S. purpurea*, and even goes so far as to state of *S. purpurea* that the leaves contain water and that they seem “to serve as an asylum or secure retreat for numerous insects, from frogs and other animals which feed on them.”

The first suggestion that these plants may have evolved elaborate traps to catch insects was made in the 1760s when the Venus flytrap was dubbed the “fly trap sensitive” by Arthur Dobbs, governor of North Carolina at the time. But the notion that the plant was deriving some nutritional benefit wasn't mentioned until 1770, when the plant was formally described as *Dionaea muscipula* by John Ellis, a textile merchant and naturalist. In his description, he states that “nature may have some view toward its nourishment, informing the upper joint of its leaf like a machine to catch food.”

This view wasn't widely accepted. At a time when all aspects of nature were considered to be God's work, the notion that a plant could devour animals was quickly dismissed, even by the great Carl Linnaeus, with whom Ellis had corresponded.



Sarracenia flava,
from Mark
Catesby, 1754.

LEFT *Drosera rotundifolia* as illustrated
in Henry Lyte's
New Herball, 1578.

LEFT *Sarracenia purpurea*, from Mark Catesby, 1754—protection or danger?

RIGHT Ellis's illustration of the Venus flytrap, 1770.



For the next century, the notion of plant carnivory was kicked to the long grass to languish alongside other absurd notions of the day. However, the discovery of new species (such as the gargantuan pitcher plant *Nepenthes rajah* on the island of Borneo) rekindled interest, and it was then that Darwin embraced the genre. In 1859 he had published his *Origin of Species*, striking the first fracturing blow to the established views of nature and its place in the world. The book's reception had at first been hostile, but since he was an established and respected scientist, his peers couldn't completely dismiss his ideas. Who better to tackle the delicate subject of carnivorous plants? *Insectivorous Plants* was the first detailed study on the topic, with much of the volume concentrating on his study of the sundew *Drosera rotundifolia*, but he also examined and included a number of other genera.

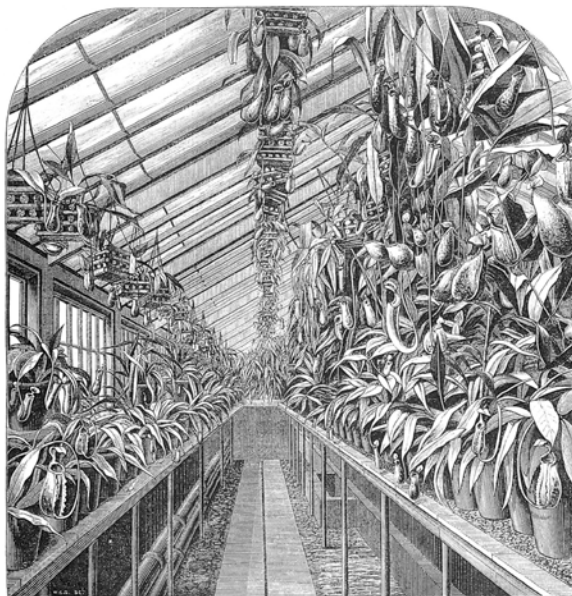
On the basis of his studies, Darwin concluded, "There is a class of plants which digest and afterward absorb animal matter." Well, it couldn't be clearer than that, and Darwin himself proclaimed, "I care more about *Drosera* than the origin of all the species."

The discovery of a huge number of carnivorous plants from around the world fuelled a frenzy of plant collecting during the Victorian era, and large collections were amassed

by those with the necessary wealth to both obtain and maintain them. Nurseries such as the famous Veitch of Chelsea, which also traded in Exeter, introduced hundreds of new exotic species to cultivation, even having a dedicated *Nepenthes* house.

This time of plenty for the fortunate few came crashing down, however, with the start of the First World War, and the amassed plant collections were lost as maintenance costs soared and interest in caring for the plants waned. Interestingly, the Chelsea Veitch nursery ceased trading in 1914, while its Exeter branch continued to operate. Most of the privately held collections were lost, and serious interest in carnivorous plants wasn't rekindled for decades.

The next great work on the subject came in 1942, with the publication of Francis E. Lloyd's *The Carnivorous Plants*, which concentrated on taxonomy rather than cultivation. Continuing the work of Darwin and more obscure studies completed in the intervening period, Lloyd's work is still regarded as relevant today, and helped bring the plants back into the limelight. A small number of individuals formed the International Carnivorous Plant Society in 1972, and that combined with Adrian Slack's book in 1979 gave the hobby a shaky rebirth.



A nineteenth-century illustration of the Veitch nursery *Nepenthes* house.

WHERE ARE THEY FOUND? TROPICAL VS. TEMPERATE

Carnivorous plants enjoy worldwide distribution. Across the temperate regions of Asia, Europe, North America, and other similar climates, they are typically bog plants, inhabiting wet, peaty areas—environments which certainly in Europe and North America have been greatly reduced due to land drainage and peat extraction. Peat is formed very

slowly by the decaying of vegetable matter, predominantly sphagnum moss. The process is lengthy because of the absence of oxygen, due to the waterlogged ground conditions. It is this slow formation that leads peat to be generally considered non-renewable, forming at the rate of around $\frac{1}{25}$ in. (1 mm) per year.

Settings such as these are generally open areas, acidic and very low in nutrients; typical vegetation includes grasses and sedges, mosses, and their most unusual residents, carnivorous plants. Which leads to the fundamental question about our subject matter: Why *are* these plants capable of consuming creatures for sustenance?

As in so many cases, where there is a need, nature provides a solution. Boggy areas are so limited in nutrients (especially nitrogen and phosphorous) that over many millennia, some of the plants in these environments adapted to catch and digest animals to supplement the meagre diet provided by the conditions. The ability to digest mostly

insects affords the plants an advantage over their non-carnivorous neighbours.

In other areas of the world, the habitats in which carnivorous plants are found vary from those in temperate regions. In countries such as Australia, South Africa, and Mexico, habitats can be only seasonally wet and then dry part of the year. This presents a challenge for the plants since a good amount of water is required during their active carnivorous phase. Certainly in the genus *Drosera* there are some interesting environmental adaptations to surviving the arid season; a couple of droseras are

annual—which means they germinate, grow, flower, and ultimately produce seed in a single season before dying. The seeds lie on the ground until the rains return, when the cycle repeats. The majority of carnivorous plants, however, employ additional tactics to survive. Some produce long, thick, fleshy roots which penetrate deep into the soil, where they retreat to survive the dry season. One group of Australian sundews goes a stage further, producing an underground tuber each year.

The Portuguese dewy pine, *Drosophyllum lusitanicum*, an unusual sticky-leaved plant which is found in coastal Portugal, southern Spain, and northern Morocco, grows mainly



A sphagnum bog in Southern England. The red-coloured plants are the English sundew, *Drosera anglica*.



on arid slopes where summers are hot and dry, and winter temperatures can drop to freezing. Again, a substantial and expansive rootstock sustains the plant in its harsh environment.

Then there are the stereotypical tropical environments that most people assume are the natural habitats of all carnivorous plants. In reality, only a handful of genera call the lowland tropics home. The rainforest evokes images of hot, steamy jungles, dense with vegetation, inhabited by leeches and other creatures ready and waiting to bite the unwary visitor. This environment (hot and humid year-round) is found at low altitude, and comparatively few carnivorous plants grow here—a few species of the tropical pitcher plant (*Nepenthes*) in Southeast Asia, and some bladderwort species (*Utricularia*), but not many other than those.

Cloud forest at the base of Mount Roraima, Venezuela.

LEFT A large specimen of *Drosophyllum lusitanicum*.

Perhaps surprisingly, looking a bit higher in altitude, where conditions are not only humid but cooler, one finds many additional species, including the majority of those in the genus *Nepenthes*. While there are currently around 150 species of *Nepenthes*, the total is increasing all the time, as botanically unexplored mountains are conquered and their green treasures discovered. In this habitat, trees are festooned with mosses, epiphytic plants such as orchids, and in some cases carnivorous bladderworts, which cling to branches.

So, generally speaking, native habitats can be roughly divided into tropical or temperate. For ease, let's assume the plants I've just mentioned fall into the former, and all others, the latter. Temperate dwellers fill the other ecological niches and contain among their number those most likely to be cultivated successfully in Europe and the United States.

Now, I'm not saying that everything other than the tropical species can be grown together, or outside, but with a little consideration to requirements, you will be surprised what you can actually grow at home.

WHAT DO THEY EAT, AND CAN THEY BE USED AS INSECT CONTROL?

It could be argued that the term "carnivorous" is something of a misnomer. It would probably be more apt to refer to carnivorous plants as insectivorous, as the bulk of these plants' diet is made up of insects. There are exceptions, however—in some cases, quite extraordinary ones.

Defining carnivorous

To begin, one must consider the attributes necessary for a plant to be classified as carnivorous. The following are all necessary criteria.

AN ATTRACTION, SOMETHING THAT ENTICES INSECTS TO THE PLANT. This is usually in the form of sugar-laden nectar, produced in copious amounts by sarracenias and other pitcher plants. Nectar is also sometimes used in conjunction with ultraviolet patterning, which renders leaves highly visible to insects.

A METHOD BY WHICH THE PLANT CATCHES AND HOLDS ITS PREY. This could be a liquid-filled bath, a mucilaginous glue, or even a sudden restraining movement.

A WAY OF KILLING AND DIGESTING THE ANIMAL. In carnivorous plants this is generally achieved by smothering or crushing. Digestion is almost exclusively through enzymatic action. A number of distinct enzymes have been isolated from different genera.

THE ASSIMILATION OF VARIOUS PRODUCTS OF DIGESTION INTO THE PLANT FOR ITS BENEFIT. As carnivorous plants exhibit a wide range of trap types (which will be explained later in more detail), the range of prey they capture also varies. Bladderworts (*Utricularia*) possess generally tiny traps around only $\frac{1}{16}$ in. ($2\frac{1}{2}$ mm) in diameter. They capture correspondingly small prey such as protozoans and tiny crustaceans; larger species occasionally add mosquito larvae.

Larger-growing plants, and those of greater interest for us, catch larger insect matter. These are carnivores such as sundews, Venus flytrap, and *Sarracenia* pitcher plants, all of which are capable of catching large numbers of houseflies, bluebottles, and wasps. Pitcher plant leaves become gorged over the course of their season, due to their capturing efficiency.

Perhaps most intriguing of all are plants capable of enticing and holding larger creatures. If ever there were true carnivores among plants, it would be select species of the tropical pitcher plants (*Nepenthes*). Their traps range greatly in size, from as small as a thumbnail to the cavernous, bucket-like pitchers of *Nepenthes rajah*. Insects are the primary diet for the majority of species, but as the traps become bigger, so do the animals caught. Small frogs, lizards, and rodents—even rats—have been found drowned in the fluid within the pitchers' traps. In cultivation these plants can occasionally catch mice.

I had a pitcher plant that I once hung in a tree outside in my tropical garden, during the summer months. One afternoon as I was walking by the tree, I noticed the tail feathers of a common blue tit (*Cyanistes caeruleus*) protruding from the plant's pitcher.



Nepenthes xmixta with a somewhat surprising prey item.

TOP A dissection of a *Sarracenia* pitcher in the autumn reveals the plant's diet of flies and similar-sized insects.

This of course is far from the norm. Indeed, it was one of only a very few documented cases of birds becoming trapped by carnivorous plants in cultivation in Europe.

Exactly how the unfortunate bird came to meet its early demise is unknown. One



A Venus flytrap with a small lizard. Larger prey such as this are somewhat unusual.

thing is certain, however: the pitcher plant was not actively attracting birds, or there would be more than a few known cases. I believe that the bird was attracted by something else, most likely the insects being drawn to the plant. I can imagine that while perched on the front rim of the pitcher's mouth, it leaned forward to retrieve an insect, became wedged in the trap, and drowned in the fluid.

The large size of the prey item, in comparison to the relatively small dimensions of the trap (some 6 in. [15 cm] from the base to the bottom of the lid), meant that the leaf decayed before any nutritional gain could be made by the plant, but it does demonstrate how some of these unusual captures can occur. This type of event isn't limited to the larger species of carnivorous plant. A number of years ago, when I operated my nursery from Surrey, a few miles south of London, I found several small lizards caught by Venus flytraps.

The diet of these plants is almost exclusively made up of insects, either crawling or flying, but they have been observed in the wild capturing small frogs—which for a large plant makes a convenient meal, as long as the animal doesn't push itself out of the leaf with its powerful rear legs. The capture of lizards is another unusual occurrence, certainly in cultivation, and again I suspect this is the result of a blunder rather than the plant actively attracting such animals.

Assuming that these plants stick to their usual diet, they make both effective and beautiful methods of insect control around the home. On a sunny windowsill, mid-height sarracenias, some species of sundew, the cobra lily, and the Venus flytrap are effective at capturing houseflies and bluebottles, and are certainly more interesting and aesthetically pleasing than those sticky-tape traps. They're also friendlier to us than chemical sprays.

In an environment such as a sunny conservatory or greenhouse, the range of plant sizes can be increased to include larger species and hybrids of *Sarracenia*—this is where an impressive display of these plants can be staged. Imagine a selection of brightly coloured, organ pipe-like pitchers in a crescendo, from the smaller species at the front up to the metre-high, fluted leaves of some forms of *Sarracenia flava*. A sprinkling of sundews and Venus flytraps completes the display. With the embellishment of a few props—cork bark or clean, salt-free driftwood—you have something capable of making the neighbours envious and the local insect population fearful. A similar setup can be achieved outside, especially in a sunny, sheltered position where pitcher plants make ideal candidates for containers on patios and decks, and even as interesting and unusual specimens for the margins of a pond.

CURRENT UNDERSTANDING

Our knowledge of the cultural requirements of these plants has increased immeasurably over the past thirty years. Plants which in the 1980s were considered to require temperatures above freezing over the winter months are in fact quite hardy. As the availability of cultivated material increased, it enhanced our understanding of the scope of their tolerances. This broader range generally comes as a surprise to people but shows just how much more widely carnivorous plants could and should be grown.

Finally, I should make a few comments concerning the names of the plants. All plants and animals have Latin names, which follow the binomial system devised by the Swedish botanist and zoologist Carl Linnaeus (1707–1778). Names consist of two parts, the generic (genus) and specific (species) names. The easiest way of understanding this is to consider the two names as make and model.

Species

Let's take the Venus flytrap, whose Latin name is *Dionaea muscipula*. *Dionaea* is the genus (make), and within that we have the species (model), which is *muscipula*. As there are no other species, this is called a monotypic genus.

With North American pitcher plants (*Sarracenia*), there are eight species, and so we

The concept of allowing carnivorous plants to freeze was alien until fairly recently.



have *S. flava*, *S. leucophylla*, and others. You will often see the genus name reduced to its first letter (which is always a capital), but the species name is almost always written in full, beginning with a lower case letter.

When a species is written down, it is correct to follow it with the name of the person responsible for describing it. So we have *Sarracenia flava* L., in which L. is the abbreviation for Carl Linnaeus himself. For the Venus flytrap, it is *Dionaea muscipula* Ellis. However, this rule is rarely adhered to and is considered unnecessary in anything other than scientific or taxonomic texts.

Varieties

Sometimes we have a situation in which a species is defined further, because of a certain stable characteristic which differentiates it, but not to the extent to which it can be regarded as a separate species. *Sarracenia flava* is a prime example, as there are seven

named, naturally occurring varieties. These are written as *S. flava* var. *flava*, *S. flava* var. *ornata*, and so on. The term “var.” stands for variety, and in this instance the varieties differ little in stature but are distinct in their colours and patterning.

Subspecies

If a plant has distinct features which go further than simply, say, colour, they are categorized by subspecies, and again we can use *Sarracenia* to demonstrate. *Sarracenia purpurea* has two of these subspecies, which are written *S. purpurea* subsp. *purpurea* and *S. purpurea* subsp. *venosa*. Although the two plants are clearly the same species, they have different natural ranges and slightly different forms, one with slimmer, hairless (glabrous) leaves, and the other with much larger, more voluminous leaves, which often have a covering of fine, short hairs (pubescence).

Forms

Occasionally we see odd forms which are given legitimate status if they are naturally occurring, and we can again use *Sarracenia purpurea* to demonstrate. Each subspecies has an all-green variety which lacks the red pigment anthocyanin, the chemical compound which gives most plants their red colouration (anthocyanin is also used as a food colourant). Such a plant could be regarded by the layman as akin to an albino, and the easiest way to reliably identify this anomaly is to look at the emerging new growth, which is usually flushed red but in these individuals is always lime green. I mention this as there are sometimes veinless green plants found which still contain anthocyanin.

So we have *Sarracenia purpurea* subsp. *purpurea* f. *heterophylla* (the f. standing for forma), and *S. purpurea* subsp. *venosa* var. *venosa* f. *pallidiflora*, wherein the subspecies itself is broken down into two distinct forms.

Hybrids

A species is a plant in its purest form. A hybrid is a cross between two or more species; in the case of *Sarracenia*, often between other hybrids, as they are all interfertile. A

primary hybrid—that is, a cross between only two species—is indicated by an $\times$ between the two names. So the cross between *S. flava* and *S. purpurea* is *S. $\times$ catesbaei*, and the cross between *S. flava* and *S. leucophylla* is *S. $\times$ moorei*. In the case of crosses between two hybrids, the name can be written as, for example, (*S. $\times$ catesbaei*) $\times$ (*S. $\times$ moorei*). Alternatively, you can list the individual components: (*S. flava* $\times$ *S. purpurea*) $\times$ (*S. flava* $\times$ *S. leucophylla*).

Cultivars

Finally, we come to cultivars. These are generally plants of horticultural origin and are names given to individual clones (genetically distinct individual plants) with outstanding characteristics. There is no limit to the number of cultivars that exist, even within an individual species or hybrid. They are given non-Latin names and are frequently named after people—for example, my own *Sarracenia* ‘Joyce Cooper’, in which the name of the plant is within single quotation marks, with capital lettering at the beginning of each word.

Here is a vitally important thing to remember with cultivars. Virtually all are so named because of a unique character, and so to preserve these attributes, cultivars can *only* be propagated vegetatively, that is by cutting, division, or tissue culture (micropropagation), in which tiny fragments of the growth points are grown in sterile jars on a nutrient jelly.

Plants should never be grown from seeds produced by a cultivar, nor labelled, swapped, or sold with that name. This applies to all plants, not just those we are covering in this book. That isn’t to say you can’t use a cultivar as a parent to produce seed; indeed there are many outstanding plants that can be raised, but the resultant offspring are to be labelled accordingly.

Very occasionally, a plant is named which has a unique characteristic that is genetic and passed on to its offspring. If it is specified in the cultivar description that any plant with this trait can be labelled as such, then it is fine to do so.

Cultivars need to be registered with a recognized body; in the case of our plants, that is the International Carnivorous Plant Society. They can also be named and described in the published catalogue of a nursery, or in a published book.



CULTIVATION IN THE HOME & GARDEN

A mixed planted
basket makes a
striking garden
addition.

A s this is a book
aimed at those with little or
no experience growing these
remarkable plants, I'll endeav-
our to keep most instructions
as simple as possible—not

because I like to patronize people, rather because I can well remember how baffled I was when I was first drawn to this hobby, by the advice of those determined to overcomplicate matters.

PROCURING PLANTS

When purchasing these plants, it really is important that you buy from a reputable specialist, for a couple of reasons. First, you are not just buying an item on a shelf, you are buying the care and knowledge of an expert grower, someone who has been through the rigours of success and many failures to develop a certain level of know-how. Good nursery folks will share this knowledge, so you are able to grow your plants successfully. Second, and just as important, you will need plants that are hard grown (grown in harsh conditions to enhance adaptability). This is the opposite of soft grown, and refers to the conditions in which the plants have been raised. In soft conditions, environments are kept at optimal levels to produce quick growth. Constant warmth and controlled light levels ensure the plants are grown in the minimum amount of time at minimum cost before they are sold. If you consider that most of us don't have these controlled conditions, you will realize that these plants won't be too happy in your house or garden and are much more likely to fail in the sudden change of conditions.

Things are different at a specialist nursery. Temperature control means opening the windows when it gets too hot to work in the greenhouses. As for heating in the winter, we don't bother if it isn't an essential requirement. So if you buy temperate plants from a specialist in the winter months, there is usually very little to see in the way of growth.

GROWING PLANTS FROM SEED

Some like the satisfaction of growing things from seed. This is possible with carnivorous plants, but be forewarned: it is a long road from seed to adult plants. Years, in fact, in some cases. If that doesn't deter you, here are some fundamentals.

Before you can grow plants from seed, seed needs to be produced. For seed to be produced, pollination must happen. This is the transference of the male pollen to the female stigma. In nature, it is usually facilitated by an animal, usually an insect. This can still

happen in many species within the confines of cultivation, especially if plants are outside where the indigenous insect population willingly performs the task. Cross-pollination happens when the pollen of one flower is transferred to the stigmas of another.

Plant reproduction

Most plants are monoecious, which means their reproductive male and female parts are found on the same flower. Dioecious plants are much scarcer, and have male and female flowers on separate plants, necessitating both a male and female plant for pollination. The only dioecious carnivorous genus is *Nepenthes*. There are a few terms concerning different types of flowers which are of relevance to us.

SELF-FERTILE A self-fertile plant is compatible with itself. While it is still preferable to pollinate with a genetically different individual, it can produce seed all on its own. If there is only one flower present, or you just have one plant, it can be self-pollinated or selfed as it is often known. The advantage of cross-pollination, however, is that the resulting offspring will be more vigorous. Selfed plants are in effect inbred, and therefore lack genetic variation.

SELF-STERILE A self-sterile plant is not compatible with itself and requires pollinating with another genetically different individual.

SELF-POLLINATING Some flowers have the ability to pollinate themselves to produce seed. These plants will still flower and seek an external pollinator but if one is not forthcoming, they have the ability to complete the process, as they close to ensure that seed is produced. Some sundew species have the ability to do this.

Manual pollination

Manual pollination refers to the fact that a plant requires an external pollinating agent, either an animal, or in cultivation, the assistance of man. This is an easy process, which simply involves the employment of a small, soft-bristled paintbrush which is used to gently brush the stamens and collect the pollen. It is then transferred to the stigma of another flower, and if you have more than one different individual clone this is even better. The pollen will stick to the stigma and the job is done. Repeat this process daily three

or four times and you will have a good seed set. For plants with small or extremely fine flowers, it is often easier to simply rub the faces of the two flowers together.

People are often wary of the perceived difficulties of growing all kinds of plants from seed (not only carnivorous plants). Indeed, there is a valuable lesson here which is relevant to a number of the plants we will cover in this book.

Collecting and sowing seeds

When virtually any seed is shed by a plant, it is in a state of dormancy, and needs to be awakened. Seeds of temperate genera, such as *Darlingtonia*, *Dionaea*, and *Sarracenia*, are usually shed in the autumn, at the end of the growing season. They have been developing throughout the summer months; remember, these plants flower prior to any leaf production. Because of their small size, if these seeds were to germinate immediately, they would run the very real risk of being killed by the ravages of winter. That's why they germinate in the spring, once the danger of freezing conditions has passed.

Seeds do not germinate immediately after shedding, because they require a certain treatment to break this chemical-induced dormancy. In the case of temperate plants, the treatment involves a period of cold to break down the chemical inhibitors contained in the seed, which facilitates germination. This is known as stratification; its practice requires nothing more technical than allowing the seed to experience a cold period.

After collecting seeds, you must ensure that they are dry. Lay them on a sheet of paper for a few days on a windowsill. Once seeds are dry, store them in a paper or glassine envelope. Do not use plastic bags for storage; there is still an element of water in the seeds and they can rot if not allowed to "breathe." Keep them in the refrigerator for six to eight weeks prior to sowing in the spring (late March to late April).

Sow them directly onto the surface of the same potting mix as the adult plant. Do not cover. Depending on the number of seeds you have, this can be done in a pot, a shallow seed tray, or in a propagator (a covered, often heated container filled with earth or potting mix, used for germinating or raising seedlings or plants). Moisten generously from above with a watering can rose, then set in water, in a sunny position under cover, ensuring they remain wet at all times (as seedlings, even the briefest period of drying out will kill them). Don't place the seeds outside, as they are likely to be scattered in heavy rain,

and remember that birds find seeds particularly appetizing. Germination should occur in four to six weeks.

If you don't wish to sow seeds the spring after they've been collected, they may remain in the refrigerator, but try to not store seeds for more than two or three years, as their viability (ability to germinate) reduces with each passing season. Some species of *Nepenthes* are viable only for a matter of a few weeks, and a couple of *utricularias* actually produce live green seeds which have to fall onto wet soil or water immediately once they are shed.

Avoid at all costs those packeted seed kits. The seeds will likely have been sitting on shelves at room temperature for many months, and are often already dead when purchased. This can be especially disappointing if they have been bought for a child. If your plan was to buy such a seed kit, make the investment and buy a fully grown plant instead.

The virtue of patience

With many carnivorous genera, especially *Darlingtonia*, *Sarracenia*, and *Dionaea*, slow growth is the norm. In the case of *Darlingtonia* and *Sarracenia*, the time it takes for a seed to grow to adult size can be five to eight years; three to five years for a hybrid of *Sarracenia*. For *Dionaea*, you will wait three to four years.

When cobra lilies and sarracenias first germinate, you will notice two small green seed leaves, followed by tiny tubular pitchers. These increase in size on a yearly basis, with the plants gaining height annually until they reach adulthood. As seedlings and young plants, they need to be treated exactly the same way as adults. They can be left in their pot or tray for two to three years before being pricked out and potted individually.

For *dionaeas*, you will again see two seed leaves followed by tiny traps, which will often become larger with each subsequent leaf, though some will stay small for longer—really, until they start catching prey. At that point, they will increase in size more rapidly.

An alternative method of sowing, one which I frequently use for convenience, is to sow in the autumn in the same way as mentioned, leaving seeds in the greenhouse to stratify over winter. Seeds will then germinate in the spring in their own time when conditions suit. This simply gives me one less task to do at a very busy time of year.

Adaptation for the southern hemisphere

In the southern hemisphere, you would sow in late September to late October. In countries such as Australia the cultivation of temperate species carries its own issues, such as providing a suitable dormant period; winters are just too warm in many areas. I have heard of growers in the hotter regions of the country unpotting their plants, washing off the planting mix, wrapping them in sphagnum, and storing in the refrigerator for three months. A rather extreme solution, but it reportedly works.

THE THREE GOLDEN RULES FOR TEMPERATE SPECIES

We've already seen that temperate species of carnivorous plants aren't the hothouse softies we so often assume they are, but they do perform best when the following important rules are observed.

As we are primarily considering the temperate species of carnivorous plants, I'll introduce you to the three golden rules for succeeding with them. Other plants of interest will be covered later, as their requirements will differ.

Golden rule number one: Full sun

The bogland habitat is too poor to sustain larger plants, creating an open environment with low-lying vegetation and little except occasional grasses to afford any shade. Plants there have evolved and adapted to tolerate high light levels, and this must be replicated in cultivation. Plants grown in insufficient light are usually pale green and insipid, bereft of the colours which make them so interesting from an aesthetic point of view, whereas those in good light are bright and vivid.

Species of *Sarracenia* fare even worse, the upright plants suffering particularly. Any pale green leaves produced will struggle to remain upright, falling over as they stretch (or etiolate, to give the phenomenon its correct term) in their search for more light. This recumbent position renders the traps quite useless.

To succeed, a good six hours of direct sunlight is required to maintain healthy growth



Two examples of *Drosera capensis*. The sundew on the right has been shaded. It's a more lax, open specimen with less colour, and isn't producing sufficient glue on its leaves.

and colouration. Don't be frightened of overdoing it—in short, you can't. Keep an eye out for sudden extreme increases in temperature and light levels early in the season, though, because developing leaves can occasionally scorch in such periods. If this happens, just remove the damaged leaves and the plant will resume growth.

With many species, especially those of *Sarracenia*, the more light the plant receives, the better the colouration, and for a few varieties the level of colour seen on wild plants is difficult to achieve in cultivation, especially in the often grey English climate. Plants grown farther south in Europe and in the United States seem to fare a little better when



it comes to reaching their potential in this respect. To put the light issue into context, my nursery receives in the region of twelve to fourteen hours of direct sun at the height of summer.

If you aren't in a situation to provide the levels of light required, all is not lost, but the number of species you can grow is somewhat curtailed. A couple of sundew species, the

A shaded sarracenia (right) lacks red colouration, and the background colour is a dull green, not the vibrant yellow that's characteristic of *Sarracenia flava* (left).

Mexican butterworts, and a number of terrestrial bladderworts are all suitable candidates for bright but sunless windows.

ARTIFICIAL LIGHT

There are times when some form of artificial light will be required—for instance, if you are growing your plants in a terrarium, if they don't receive enough natural light due to position, or if you are trying to encourage growth early in the season. Understanding a little about artificial light and how it relates to natural light can help you choose the right setup.

Plants require light to undertake the process of photosynthesis, light that is supplied in the visible spectrum from the sun, and of the type that we as humans can see. This fairly narrow bandwidth appears at first glance to be white light, but as we know, it can be split into the spectrum of colours—think of a rainbow.

The sun supplies light across this spectrum from violet to red, and so plants receive the whole range of colours. They rely on the violet end of the spectrum for healthy growth, and the red end to facilitate flowering.

Artificial lighting typically provides light from a very narrow bandwidth, often from either the red or violet end, which will prompt either growth or flowering. Lighting is available, however, that has a wider bandwidth and is therefore more suitable as an all-around solution. Let's have a look at some of the more common options.

FLUORESCENT LIGHTING is the best option for most hobbyists and for terrarium cultivation. It is available in a variety of lengths, and is relatively cheap to purchase (and certainly cheap to run). It does require a starter unit (ballast) which can easily be concealed, and several tubes can be mounted in the lid, allowing tubes from different ends of the spectrum to be used together. Full spectrum lights are also available. A trip to the nearest aquarium or reptile supplier will give you a good idea of options.

A reflector mounted above the lights is essential, and the plants will need to be positioned 6 to 12 in. (15 to 30 cm) below them. Fluorescent lighting operates at a low temperature, so there is little risk of burning the leaves unless they come in direct contact with the tubes.

LED (LIGHT-EMITTING DIODE) LAMPS are fairly new technology as far as grow lights are concerned. They have the advantage of being cheap to run individually, but

more important, of being very bright collectively, while producing little or no extra heat—though this could also be construed as a negative. I've not used LEDs personally, but there are a number of options and a dizzying amount of conflicting information, facts, and figures. In light of this and the fact that the technology seems to be changing and progressing quickly, a little research will be required prior to purchase. There are many types of LED units available on the Internet; keep in mind that you usually get what you pay for.

HID (HIGH INTENSITY DISCHARGE) LIGHTS are the units used in commercial nurseries, and hence suited to larger greenhouse applications. They are completely unsuitable for terrarium use.

Sodium vapour HID lamps produce light from the red end of the spectrum, and are used extensively to produce flowering plants for the mass market. The light they produce is warm, however, and not conducive to viewing plants.

Metal halide HID lamps have a broader spectrum that is concentrated in the blue end, so they encourage growth. The light they produce appears almost white to human eyes and lifts the colours of the plants. Subjects photographed under this type of light, though, appear yellow. In a greenhouse situation they are a handy addition to natural light, and I use them occasionally to kick-start the growth of sarracenias if I have an early flower show at which I'm exhibiting.

HID lights are expensive to purchase; require a large, heavy ballast that can buzz irritatingly; and, at 400 or 600 watts per bulb, are very expensive to run. In short, they are of little use to the amateur hobbyist.

All these light types will need to be set on a timer to allow a photoperiod (period of time each day that an organism receives illumination) of twelve to fourteen hours per day, unless they are being used as supplementary lighting. Standard plug-in timers for fluorescent tubes and LED lights are fine. Consult a well-stocked electrical supplier, preferably in conjunction with a qualified electrician.



Water collection tanks connected in sequence at their bases dramatically increase storage capacity.

Golden rule number two: Keep plants wet with rainwater

I say rainwater, but this can be widened to include other options, so don't panic if you live in a flat and have no capacity to collect it. Water is an important component, though, and one which will kill your plants if you don't get it correct. People constantly ask me at flower shows why their Venus flytrap died, and the answer is invariably because they used tap water.

What's the problem? The chlorine level is a consideration, but this will dissipate if water is left to stand for twenty-four hours. The main issue is the hardness of tap water, which is essentially the level of dissolved minerals it contains. In Britain and the United States, our drinking water is generally considered to be hard. Some areas are fortunate to have soft water, but even in those areas I would shy away from using it.

A common misconception about tap water is that it is okay to use if it has been boiled. People assume this removes all impurities; unfortunately it isn't that simple. Tap water contains two types of hardness: temporary and permanent. Temporary hardness precipitates out as the water boils. In hard water areas, this can be seen as scale in the kettle. It is the carbonate element of the hardness. Permanent hardness, however, isn't removed by boiling. This sulphate hardness remains in the water and actually increases in concentration as water boils and evaporates, rendering the water even more unsuitable. Filtering tap water is also not recommended. Filters often use salts to soften the water, with some just removing the temporary hardness. Bottled mineral or spring water should be avoided, as they usually contain a higher level of mineral salts.

The best and cheapest option (and the most reliable in many parts of the UK and North America) is rainwater. A water tank that collects from a downspout off the roof is the best method to ensure a good supply. Downspouts from tiled, glass, or polycarbonate roofs are all fine, but be aware that concrete tiles will contain lime (calcium carbonate), which will harden your water and could make it unusable. Install the largest collection tank you can; it's surprising how quickly the supply goes down in a period of hot weather. If you have a number of plants, it may be a good idea to link a few tanks together.

Any sturdy plastic water tanks are suitable, as is a simple bucket placed under a downspout if you just have a single plant. It is advisable to install some kind of filter to

the downspout to prevent leaves and other debris from soiling your water supply. The cheapest and most effective filter is a double layer of women's tights, fixed securely at the end of the pipe.

If you have no access to rainwater there are alternatives—not all as inexpensive as the stuff that falls from the sky, unfortunately. Water from an air conditioning unit or dehumidifier is produced by simply condensing moisture from the air—fine for use. Distilled and deionized water is also suitable, such as the kind available for use in car batteries and irons. Deionized water has been through a chemical purification process to remove the mineral ions. Distilling water is a much more energy-intensive process; water is boiled and the resultant steam is condensed. Both processes result in water of a similar purity. Reverse osmosis (RO) water is also fine, but requires the purchase of an expensive RO unit for home production. This device filters out impurities by forcing the water through a semipermeable membrane, producing water with an impurity level as low as 10 parts per million (ppm). However, this method will convert only 5 to 15 percent of the water that enters the system, resulting in a large quantity of wastewater unsuitable for use on any plants, due to its high level of mineral salts.

Golden rule number three: Cold dormancy

Temperate regions of the world witness distinct seasons, generally with hot summers and cold winters. Plants have to adopt a growth pattern to suit their environment. Trees are the most obvious example of this adaptation, with many species in growth during the summer months, then losing their leaves for the winter when growth ceases.

Plants from these regions, most notably *sarracenias*, some *droseras*, *dionaeas*, and *darlingtonias*, require similar treatment in cultivation if they are to survive in the long term. In autumn, they will die back and lose their leaves in readiness for winter. *Sarracenias* die back from the top of the pitcher gradually down to the base; the speed at which this is done varies greatly between species.

Sarracenia oreophila has a shorter growing season than the other species, and can lose its leaves entirely over a period of only two to three weeks late in the summer. On the other hand, a couple of species, including *S. leucophylla*, have a second crop of leaves which can last well into winter; these are lost before the following spring, when new leaves

emerge. Do not panic when this die-back happens, as there are always green leaf bases left on the plant. The exception is *S. oreophila*, but that plant produces non-carnivorous winter leaves.



Leaves of *sarracenia*s dying back in the fall. Don't worry when you see this happening.

The Venus flytrap tends to lose some of its leaves, especially those held erect, and retains a small, flat, basal rosette. Occasionally a plant will lose all its leaves, yet a little excavation will reveal that the plant is not dead, but in fact alive and well.

The sundew species found in temperate regions employ a slightly different method. These are much smaller, more slender plants, which lose their leaves and produce a tight winter resting bud to protect themselves from low temperatures. These buds are composed of the much-reduced last leaves of the season and are held low to the ground, covering the growth point within.

All these plants require a similar cold rest period in cultivation. I often hear that people have lost their plants, and if it's not due to watering with tap water, it is invariably because the dormant period hasn't been respected. Creating this state isn't simply a case of leaving the plant in a cool room. When one considers the temperature

ranges of their natural habitats, it's evident that these plants are capable of tolerating a far lower temperature than many realize. Much of Europe witnesses winters with long periods of weather below 32°F (0°C), as does the southeastern United States, where the greatest concentration of temperate carnivorous plants exist.

For the rest of the world, it's sometimes hard to imagine cold weather in Florida, especially as it's marketed to potential visitors as the Sunshine State, but of course the farther

Winter Requirements

WINTER REQUIREMENTS AND IDEAL POSITIONS FOR PLANTS

OUTSIDE (MINIMUM 5°F / -15°C)	UNHEATED GREENHOUSE / SHED OR CONSERVATORY/ GARAGE	WINDOWSILL	HEATED GREENHOUSE (MINIMUM 45°F/7°C)	HEATED GREENHOUSE (MINIMUM 54°F/12°C)
All <i>Sarracenia</i>	All <i>Sarracenia</i>	South African <i>Drosera</i>	South African <i>Drosera</i>	Highland <i>Nepenthes</i>
North American and European <i>Drosera</i>	North American and European <i>Drosera</i>	Mexican <i>Pinguicula</i>	Mexican <i>Pinguicula</i>	
European <i>Pinguicula</i>	European <i>Pinguicula</i>	<i>Cephalotus follicularis</i>	<i>Cephalotus follicularis</i>	
<i>Darlingtonia californica</i>	<i>Darlingtonia californica</i>	Terrestrial <i>Utricularia</i>	Terrestrial <i>Utricularia</i>	Terrestrial <i>Utricularia</i>
Turion-forming aquatic <i>Utricularia</i>	North American <i>Pinguicula</i>		Most <i>Heliamphora</i>	Most <i>Heliamphora</i>

north you go in the state, the colder it becomes. Tallahassee has experienced a winter low of -2°F (-17°C).

In the UK, temperatures of below 14°F (-10°C) are fairly unusual, certainly in the southern half of the country. I’ve witnessed temperatures this low on two or three occasions, one such time a number of years ago while camping in January! It follows that the farther north one travels, the colder the temperature becomes, and with the correct climatic conditions there can be a disparity of up to twenty-seven degrees Fahrenheit (fifteen degrees Celsius) between the Scottish Isles and London.

European growers aren't as fortunate, and see much colder winters, though they can still succeed with their plants in such hostile climates—proving just how cold-tolerant the temperate species really are. The level of cold dormancy these plants endure, and indeed require, is very much understated, making it important to not leave temperate plants in the house because of cold outdoor weather. It will be far too warm inside.

Rather than placing a *sarracenia* on a cool windowsill in the house for the winter, put it in either an unheated greenhouse, or outside. There are a couple of species which seem to benefit from a little protection from the elements: *Sarracenia psittacina*, and in some areas, *S. leucophylla*.

From my nursery work, taking these plants through winters over the last thirty-five years, I've found that the harder the winter they endure, the better they seem to grow the following season. Of course, there are other factors at play which could have a bearing, such as sunlight hours, but it is a pattern that seems to repeat itself.

Sarracenia is able to withstand a winter minimum of 5 to 14°F (-15 to -10°C). It follows that our native species also need to be left outside, or at least in a cold, unheated greenhouse, as a warm winter period will soon kill them.

This low temperature requirement is not essential for those other species so easily grown as windowsill and greenhouse plants, which hail from otherwise milder climates. For example, the many and varied sundews from South Africa, a good number of which are easy to grow in the home, can generally be kept on a sunny windowsill year-round if the temperature remains above freezing. The same applies to Mexican butterworts (*Pinguicula*). Although some can tolerate a brief freeze, I would advise against taking the risk.

We should also consider what extremes can be tolerated at the other end of the spectrum. In the confines of a greenhouse or conservatory, temperatures can soar on a hot summer day; a little ventilation is required on these occasions. My nursery greenhouse, at 30 by 100 ft. (10 by 30 m), is a little larger than the average garden structure. But even with the many roof vents open, it can reach 120°F (49°C). That's too hot for me to work in, but the plants, as long as they are kept wet in 2 to 3 in. (5 to 7 cm) of rainwater, are fine. At these temperatures, young plants may struggle (especially some species of sundew), and *Sarracenia oreophila* will be pushed into an early dormancy, but there should be no long-term detriment.

POTTING MIX

To grow carnivorous plants successfully, a small range of materials will be required for potting mix (also referred to as compost in the UK). This may seem daunting, but don't worry as it's not the fabled rocket science you would be led to believe. I'll cover each ingredient individually, and we'll tie them all together with the different plants later.

PEAT MOSS

As we've seen, many of these plants are inhabitants of peat bogs, and so peat moss (called moss peat in the UK) is the base for most of the mixes we'll be creating. Peat is a divisive issue in the UK and there are current government drives to reduce its use.

There are two types of peat available: peat moss, which is what we require, and sedge peat, which is unsuitable as it can be slightly alkaline. Sedge peat is also sold as "Rich Dark Peat," so beware. Peat should be pure, with no additives, fertilizer, or wetting agents.

Peat moss is a dark brown colour and has a rich, slightly earthy aroma. It often contains larger lumps or fibres, all of which can be used. It is an acidic material with a pH of between 3 and 5. Peat moss maintains its structure well, which is one reason it was marketed as a soil improver for many years, a practice which I can't endorse. It is a finite resource, and one that shouldn't be squandered. However, peat-fired power stations can be found around the world; each burns more than a million tons of the material every year. I'll leave you to argue the ethics of that one.

SAND

The sand of which we need to avail ourselves must be primarily lime-free. It can be (preferably) silver sand or horticultural sand, but an important word of caution: even if the



It is imperative that any sand you use be lime-free—don't necessarily trust what's written on the packaging.

TOP Peat moss, not to be confused with sedge peat.



Perlite.

TOP Cornish grit.
Note how coarse
the particles are.

package states “lime-free” or “washed” it may be anything but. A number of years ago, I was experimenting with potting mixes for *Sarracenia* and lost over 500 plants because I trusted what was printed on a bag.

Avoid children’s play sand and building sand, as both are unsuitable, and building sand is also unwashed. Generally, good-quality, clean-looking silver sand with a pale yellow colour is fine, but a quick check with a soil pH testing kit will take only five minutes—and could potentially save you a lot of extra work repotting later.

CORNISH GRIT

Cornish grit is crushed granite that is available in different grades, coarse and fine. Fine is a good alternative to silver sand. Coarse is useful for some potting mixes which need to be more open in nature. It is a silver-grey colour which makes an ideal contrast to plants such as Mexican butterworts.

PERLITE

Perlite is a natural material derived from obsidian, a volcanic glass. When tiny fragments are heated they expand greatly, turning white in the process. Perlite is used in hydroponics, as a material in which cuttings can get started. It is also used in potting mix, where its high permeability and low water retention make it an ideal addition to prevent soil compaction. It is com-

pletely inert, adding only structure and no nutritional benefit, and is a good alternative to sand in a number of cases.

VERMICULITE

Only a handful of the Mexican butterworts (*Pinguicula*) will utilize vermiculite, but it’s important to mention, as it’s often confused with perlite. It is a silicate material which, like perlite, expands when heated to form small fragments of layered, slightly gold-coloured



LEFT Vermiculite. Note how it differs from perlite, though the two are often confused.

RIGHT Orchid bark. Choose a coarse grade of orchid bark for *nepenthes* plants. It will be used in conjunction with sphagnum moss.

pieces. Again, it contains nothing in the way of nutritional value and is used to create structure. It has various applications as a heat-proof material—I was more than a little surprised to see my new oven at home filled with it prior to installation.

ORCHID BARK

This will be used with only one genus, *Nepenthes*. As the name suggests, orchid bark is primarily produced for the orchid fanciers' market, but it is a valuable material for us as well. It is usually pine in origin, and is available in medium or coarse grades. I prefer the coarse.

SPHAGNUM MOSS

Sphagnum is the genus of moss that degrades over time to produce the bulk of the peat in wetlands. In its live or dried form, it can be used as a planting medium, especially for *nepenthes* plants, but also as a topping for potting mixes for other species. It is also used outside in bog gardens.

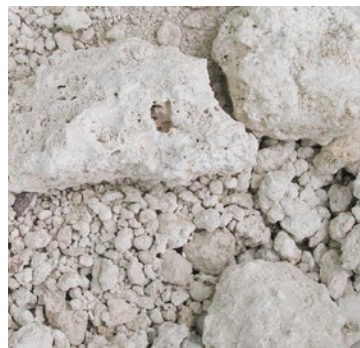
Sphagnum is a beautiful moss; in its live state it displays a wonderful array of green and red. It can also be purchased in a dried and compressed state, which when rehydrated will soon colour up, producing the most wonderful green carpet. Unfortunately, it is also



LEFT In its dry state, sphagnum moss is light brown in colour.



CENTRE Hydrated sphagnum returns to a luscious green.



RIGHT Tufa, ground and as larger pieces.

highly prized by birds as ideal nesting material, and an errant chicken can wreak havoc with your deep-pile emerald rug.

TUFA

Tufa is a type of limestone, which at first glance is an odd ingredient to use with carnivorous plants as it is alkaline in nature, but as with most things there are exceptions. It is a soft, crumbly rock and can be used with certain species of *Pinguicula* (especially the Mexican butterworts, which are found in alkali conditions), and some rarer European species.

COIR AND PEAT ALTERNATIVES

With the efforts to reduce the use of peat in horticulture, there are alternatives. Much of the experimentation is in its infancy and I have seen various products suggested: pine or larch needles, pure sands, sphagnum moss, and most commonly coir, which is derived from coconut husks. While coir is an alternative, it's important to note that the coconut industry is not without controversy either, causing the destruction of virgin forests.

Coir is available from specialist suppliers in various guises, most conveniently as compressed blocks which require soaking prior to use. A search online will turn up a supplier in your country. Ensure that any coir you purchase is washed, as it can be high in salt, which will be poisonous to your plants. It can be used in various mixes where peat is used, but I would suggest experimenting with a couple of surplus plants initially.

Potting Mixes for Carnivorous Plants

PLANT	POTTING MIX
<i>Cephalotus</i>	Peat and sand 1:1
<i>Darlingtonia</i>	Peat and perlite 1:1
<i>Dionaea</i>	Peat
<i>Drosera</i> (pygmy and tuberous)	Peat and sand 1:3
<i>Drosera</i> (other species)	Peat and sand 1:1
<i>Heliophora</i>	Peat and perlite 1:1
<i>Nepenthes</i>	Sphagnum moss and orchid bark 1:1
<i>Pinguicula</i> (temperate European acidic)	Peat and sand 1:1
<i>Pinguicula</i> (temperate European calcareous)	Peat, sand, and tufa 1:1:1
<i>Pinguicula</i> (Mexican)	Peat, perlite, sand, and vermiculite 1:2:2:2
<i>Sarracenia</i>	Peat and perlite 1:1
<i>Utricularia</i> (terrestrial)	Peat and sand 1:1
<i>Utricularia</i> (epiphytic)	Lower half of pot peat; upper half sphagnum moss and orchid bark 1:1

CONTAINERS

What are the best containers in which to grow one's plants? Let's begin by looking at what is not suitable. Clay pots, although perhaps more attractive, are unsuitable for all but one or two carnivorous plants. As the plants generally need to stand in water, they rapidly become covered in unsightly moss and slime algae. The porous quality of clay pots means that they will dispatch precious rainwater as it evaporates from the sides—far more than plastic pots. Containers made of concrete are also unsuitable because they

A tray of sarracénias on a sunny windowsill. Cheers!



contain lime. However, pots made from either of these materials can be fine if they are lined and waterproof.

My container of choice is plastic. The standard-depth terracotta-coloured pots are perfect, but I prefer to use black, as the colour complements the occupants, something I find with all plants. I also prefer square pots; they provide a greater upper surface in which plants can wander around, and make better use of space on a greenhouse bench.

Pot size is important, and it can be surprising just how large plants can become, especially sarracénias. As a general rule, carnivorous plants harbor no aversion to being a little pot bound, but when they have filled their containers and begin to distort the pots, they are in definite need of moving up a pot size or two. Larger plants will require larger accommodation, and I have display plants in 5-gallon (20-litre) pots with a diameter of 13 in. (32 cm) and larger.

Various troughs can be utilized to produce small displays of maybe four or five plants for a windowsill. You can stand a number of pots in larger, deep plastic trays—ideal in a sunny conservatory.

Troughs and other decorative containers can be planted for a more professional finish.



WHERE TO GROW PLANTS OF PREY

Metal troughs are great for contemporary settings. The powder-coated variants can be coloured, which lifts the colour of the plants within.

Despite their exotic looks, most carnivorous plants can find happy homes in temperate climates around the world, either inside or as an ornamental addition to the garden.



Venus flytraps on a bright windowsill.

ON THE WINDOWSILL

There are a number of species which are ideal for windowsill cultivation, especially if the window receives direct sun. Some species will survive on a window that gets afternoon and evening sun, as it is stronger than morning light. Remember, the more direct sun a plant receives, the better it will grow and colour. Ideal candidates for the windowsill are the Venus flytrap, all the pitcher plants, *Sarracenia* (except the very tallest plants unless you have large windows), and all the commonly grown South African sundews (*Drosera*).

If you have only low-light windows, your choice is somewhat limited, but there are still plants that can thrive in such locations. Mexican butterworts (*Pinguicula*) and the fascinating terrestrial bladderworts (*Utricularia*) are ideal for these situations, as they don't require full sun. Both of these can produce the most wonderful flowers, and can be in bloom for months at a time. Although their small stature means they're not exactly going

Three striking carnivorous plants on a sunny windowsill: (left to right) a sundew, a pitcher plant, and a Venus flytrap.



to Hoover up annoying houseflies and wasps, their captivating beauty helps us forgive their small appetites.

Another candidate for the windowsill is a peculiar relative of *Sarracenia*: the cobra lily (*Darlingtonia californica*). This unique pitcher plant, complete with twisting forked tongue, can tolerate slightly lower light levels than its cousins because of the way in which the pitcher is hollow along its length to the base, thus giving it a stronger structure. That's not to say it doesn't like the sun; it can colour as spectacularly as *sarracenias*, but it does have an aversion to overheating, which can usually be avoided with windowsill placement.

It probably goes without saying that as windowsill residents, these plants prefer to be next to the glass and not behind shading such as curtains—although curtains can be helpful in allowing those shade lovers to be grown in a sunny spot. One thing to bear in mind is that some plants require a cold rest period; refer to the winter requirements table in the previous chapter for specifics.

IN THE GREENHOUSE AND CONSERVATORY

I'm including greenhouse and conservatory together, because they are essentially the same, the latter perhaps a little more conducive to relaxing on a lazy afternoon.

In this environment, the number of plants you can grow and the perfection which you can achieve is greater than elsewhere. Again, position is everything and a sunny conservatory is best. I've seen some exceptionally well-grown plants in conservatories with orientations other than south, as long as the sunniest spot within has been chosen. Indeed, these are ideal plants to put in that hot spot where little else grows and the thought of a cactus is uninspiring.

Here you can create a display of plants where you can appreciate their beauty and they can earn their keep, diverting wasps from your afternoon snacks. With a deep windowsill, a large plastic tray can be positioned next to the glass, or a small table can accommodate a more substantial arrangement.

Simply stand the plants in the tray and fill it with rainwater. Then make sure it never dries out in the growing season, keeping plants just damp in the winter. Remember, these are predominantly bog plants and you can't overwater them. I'm often asked what to do in the summer during vacations and holidays. Just stand the taller plants in buckets and fill them up and above the potting mix surface, even as far as half way up the leaves. Smaller plants can cope with similar conditions; again, ensure half of each leaf is above the water surface.

Why do I say to just keep them damp over winter, since bogs are generally even wetter places at this time of year? Consider where you're growing. In the greenhouse or conservatory, we usually keep the doors and windows closed in the winter, and the air within is still. Fungal spores which are naturally present in the air will settle rather than be carried around on air currents, landing on plants and attacking any dead leaves, especially if the plants are too wet. By reducing the moisture, you reduce the risk of plants developing grey mould (*Botrytis cinerea*), a disease which can kill plants but is easily preventable.



A glazed ceramic pot holds a *Sarracenia* hybrid.

TOP *Drosera binata* makes an ideal subject for a hanging basket.

In a greenhouse situation, it is usually easy enough to leave doors open a few inches, or to install an electric fan for airflow. There are a number of fans available specifically for this purpose. If your conservatory is unheated and freezes, your plants can be left in

situ, though remember to remove those that require a little heat.

The range and number of plants you can grow in a greenhouse increases dramatically, and it is in this environment that you can find yourself on a slippery slope. Remember, like many others, I began with a single plant—and have spent the last thirty-five years struggling for available space to house my ever-increasing collection. It's imperative, therefore, if you are going to purchase a greenhouse, that you buy the largest your budget and space can accommodate, as it is surprising how quickly you will fill it.

I prefer aluminum-framed greenhouses, as they are stronger, longer lasting, and more affordable. Avoid the flimsy, cheap things you see advertised; you're never going to drink champagne on beer money. Go instead with a reliable and trusted manufacturer.

Next you will need benching, usually a width of 2 to 3 ft. (60 to 90 cm) along each side. With a greenhouse 12 ft.

(3.5 m) wide or more, you can comfortably accommodate a middle bench, a handy addition for the tallest of the sarracenias. Be sure to purchase strong, all-aluminum benching. Remember, the extra water these plants need makes them very heavy, and the last thing you want is a collapsed mess. Having a bench that is entirely aluminum also eliminates the risk of it rotting, saving you money in the long run. I prefer slatted benching as it is stronger than the flat sheet aluminum variety.

The position of the greenhouse is important, and you will usually have more choice in this aspect than you will have with a conservatory. A sunny orientation is best if you have it, where it will receive direct sun for the longest period. Remember, if you are growing species which require a little shade, that is easy to add, whereas you cannot add extra sun.



Larger sarracenias can be placed in a deep plastic tray. The addition of a few pieces of cork bark adds interest and helps hide the pots.

If the greenhouse is in a prominent position in the garden, and certainly if you have children, safety glass is an essential (albeit more expensive) necessity. Even if safely fenced away, the greenhouse is still somehow a magnet for errant footballs.

Now you have a decision to make. Do you require heating for the greenhouse, or are you going to concentrate on the cold-growing species? Let's assume some heat in the winter will be required, in which case there are a few options.

Gas heaters are fairly cheap to purchase, and can run from a propane cylinder. They are clean, but do produce moisture as a result of the combustion. Avoid anything that burns butane—it is not as effective in cold temperatures, just the time when you need it. The cylinders will need regular changing, and it is a good idea to have an automatic changeover valve which connects two cylinders, swapping them over when one empties in readiness for you to replace it. Although heavy, large propane cylinders are best in terms of convenience and value, they will require a suitable trolley to move them around if you wish to avoid injury. Gas heaters are also fitted with a thermostat, giving you control over the temperature. Kerosene (paraffin in the UK) heaters are still available, and this was the method I used to heat my first greenhouse. They are fairly inexpensive to buy, but increasingly expensive to run, as you rarely find hardware shops with kerosene pumps in store now, and instead have to rely on ready-bottled fuel. They burn with a hot blue-orange flame. As well as producing moisture, kerosene heaters also coat everything with a sticky residue, and are somewhat dirty. There is no control in the form of a thermostat, meaning they will need regular relighting and extinguishing, and the wick will need to be trimmed to ensure that the flame burns cleanly and doesn't produce smoke. I would avoid this option if given the choice.

Remember, anything that heats with a burning flame will require a small amount of ventilation to ensure the flame isn't extinguished, though this is unlikely in a greenhouse environment. Electricity is increasingly expensive to buy, but is more controllable, convenient, and reliable—and, if you hadn't guessed, my preference. Electric heaters specifically designed for and safer to use in a greenhouse will cost more than basic models, but are worth the investment. Heaters with fans can be set to have the fan run continuously, and hence maintain a degree of air movement at all times. Most have fitted



Sarracenias thrive in a greenhouse environment.

thermostats, which are generally quite accurate—to within a degree or two—making them very efficient.

The most expensive aspect of this option is the electricity supply to the greenhouse. If you have a powered garage nearby, it is usually more convenient to spur off of that supply, but please get a professional to do the work. Remember, you are connecting a live electrical supply to a glass and metal box with metal benching, with the addition of copious amounts of water. These components could be a recipe for tragedy, so use external fittings and covered sockets which are waterproof. There are some things I refuse to mess around with, and electricity is one of them.



Alliclips, used for securing bubble insulation to the channel in aluminum greenhouse bars.

Another consideration for the winter is insulation. Heating a greenhouse can be costly, and with no insulation, somewhere around 50 percent of the heat will be lost through the glass. A single layer of bubble insulation will reduce your heating bill by a similar amount. This insulation is different from the packing bubble material, as it is double skinned and UV stabilized to ensure a longer life. It is available in two grades, one with small bubbles $\frac{3}{8}$ in. (1 cm) in diameter, and the other $\frac{3}{4}$ in. (2 cm) in diameter. I prefer the larger; it has greater insulation properties and better light transmission, and is more hard wearing, ensuring I can reuse it for three or four years. It is more cost effective

to purchase a roll rather than short sections if you require a good amount, and a horticultural wholesaler will be able to supply it.

There are a couple of widths of bubble insulation available, the best being 5 ft. (1½ m). Fitting it is an easy enough process; I simply run a length of it along the centre of the roof, and one along each side, with a slight overlap. If you have a wooden greenhouse, you can purchase heavy duty pins to secure the insulation to the frame. Aluminum-framed greenhouses usually have channels which are designed to take small plastic clips known as “alliclips.” When simply pushed in and turned, these secure the insulation.

Try to cover the entire structure in this way. To grow the widest range of plants in a single greenhouse you will need to maintain a minimum winter temperature of 45°F (7°C). Your heating bill could be further reduced by the addition of a partition, so only half of the greenhouse is heated—preferably the rear section, which is less vulnerable to draughts from the doors.

These amendments will enable you to grow species which do not require any heat alongside those that do. For many years the bulk of my collection was in a single 8 by 12 ft. (2.5 by 4 m) greenhouse, in which I installed a bubble insulation partition midautumn. *Sarracenias*, *darlingtonias*, *dionaeas*, and cold-loving *droseras* and *pinguiculas* lived in the front section, while the rear half housed everything else except *nepenthes* plants, which require more specialized care, as we shall discuss later. If your greenhouse is large enough, you may wish to consider a glass partition, which you can install during assembly. With the arrival of warmer, sunnier days, remove the insulation and store it until the following winter.

Your plants will need to be standing in water for most of the year, and the easiest way to achieve this is with large trays. Unfortunately, those available for such purposes are generally too shallow or too small for greenhouse use, and you would be refilling them every day. I found making my own trays to be the best option.

Trays of the size made in the accompanying do-it-yourself project (opposite) are much easier to keep full of water during the summer. If you are fortunate enough to have a power supply and a water butt connected to the guttering on the greenhouse (or preferably, several connected together), you can suspend a submersible pump in one and pump the water via a hose directly into the tray, saving yourself considerable effort. If you don't have a power supply, the exercise will do you good.

Hygiene is an important consideration in a greenhouse environment, to reduce the risk of pests and diseases. Any dead material should be routinely removed from the plants and disposed of, and the floor swept clear of debris after each purge. Keep the glass clean—especially in areas of high rainfall, which encourages the growth of algae. A wipe with a window-cleaning rubber squeegee followed by a rinse with clean water will eliminate any build-up and subsequent loss of light transmission. This is best performed early on a sunny spring morning, after the doors have been closed overnight to ensure there is condensation on the inside of the glass. Any algal build-up will be soft and easily removed. Once every year should be more than sufficient. As with the conservatory, the water should be reduced over the winter months, to minimize the risk of grey mould.

Finally, a word on safety. As a father, I soon learned to recognize areas of hazard. I've already mentioned safety glass, which to reiterate is essential if children will be around. But also consider danger zones in the rest of the greenhouse. Sharp corners on aluminum

Create your own plant tray

1. Line the benching with sheets of ¼ in. (4 mm) plywood.
2. Make a frame using 1 by 4 in. (25 by 100 mm) sawn timber, held together on the external corners with 90-degree metal brackets, ensuring the screws do not protrude through to the inside of the frame. The length you decide upon is entirely dependent on the length of your benching, and also on the necessity for the bench to be level.
3. Line the frame with pond liner and nail the outside overlap with ½-in. (13-mm) galvanized nails, ensuring there is sufficient liner tucked into the inside of the frame so it is not stretched when full of water. The liner

can be made of PVC or butyl (though PVC is considerably less expensive), and either can be purchased from an aquatic supplier. A thickness of ½ mm is perfect. Make sure it is UV stabilized. Avoid any other plastic sheeting, as the sun and heat in the greenhouse will degrade it in a surprisingly brief time, resulting in it splitting and draining—invariably on the hottest day of the year, while you are not around. Although pond liner is more expensive, it will last years, even in this environment. Don't be tempted to use woven liner as this has very little strength, something I learned the hard way.

4. Trim the excess liner from the outside.

benches seem to be just the height of a two-year-old's forehead. Cover such corners using pipe insulation and cable ties. Store chemicals outside easy reach. Keep water containers covered and secure lids if possible. A quick look-around can save mishaps, tears, or worse.

IN THE GARDEN

Many gardeners struggle with whether or not their outdoor environment is viable for growing carnivorous plants. However, with the application of a little thought and, sometimes, ingenuity, locations that may not seem hospitable can produce surprisingly successful results.

A warning, though: every condition is different. My garden, for example, is slightly more protected than my neighbours' because of how I've planted it. It has a marginally different microclimate, which enables me to grow plants that they cannot, and vice versa. What works for one may not for others, but as you will see, I have collected successes from growers in various countries.

The bog garden

A bog garden is the stereotypical method of outside cultivation, and in its purest form, amounts to a hole dug in the ground and lined. The size of this garden will depend on your objective and the space available, but the primary consideration should be position. Choose a site that receives at least five hours of direct sun in the summer. If you hope to grow the taller species of *Sarracenia*, select a location with protection from strong winds. If your site is open, just choose shorter-growing plants.

Be aware that in a hot summer, you will still need to water your bog garden in all likelihood, so don't position it too far from a water supply. By ensuring a good depth, you will reduce the frequency of watering.

Dig it as you would a pond. Either a liner or a pre-formed plastic or fibreglass moulding can be used, but if you are using a liner, choose a high-quality one. A fleece underlay is a good idea to prevent sharp stones from piercing the liner—worth the small extra cost.

Once lined, or positioned in the case of a moulded pond, fill to within a couple inches of the top with peat moss, firm down, and level as best you can. To reduce the amount of peat moss you use, add 50 percent perlite or washed gravel if you prefer. Now slowly add water (a hose from a rainwater barrel is ideal), until the peat is saturated. Leave to settle overnight and trim the excess liner, or obscure it under stones if appropriate the following day.

Position your selected plants on the surface, moving them around to find the most pleasing arrangement before planting them in the peat moss. Add a good quantity of sphagnum moss to the surface, which will grow across the bog and complement your plants.

Finally, adding some props, in the form of cork bark sections, salt-free driftwood, or the like, will further enhance the finish.

TOP LEFT Fill the pond with peat moss, add water, and allow to settle.

TOP RIGHT Position your selections before planting.

BOTTOM *Sarracenia flava* var. *ornata*, *S. purpurea* subsp. *purpurea*, *S. oreophila*, *S. xatesbaei*, and *Drosera filiformis* var. *filiformis* thrive in this bog garden.



Suggested plants include all *Sarracenia* (except *S. psittacina*, which tends to get rather lost among the sphagnum). All hardy sundew species (*Drosera*) are suitable; I've often used the North American *D. filiformis* var. *filiformis*. Finally, any of the hardy butterwort species (*Pinguicula*) can also be added, along with the cobra lily, *Darlingtonia californica*.

The best time to create this type of bog garden is in the spring, when the plants have a complete season in which to establish themselves. Next, let's have a look at a few bog garden features created by people in different countries and settings.



WALES

Ian Salter has created his bog garden in an existing graveled area, next to one of his greenhouses, which adds an extra level of interest and also serves to draw the eye and greenhouse visitors outside. It was dug to a depth of 2 ft. (60 cm) and all sharp stones were removed. A layer of sand was added to protect the pond liner, which was then used to contain the bog. The hole was filled with peat moss and allowed to settle as described previously, before drawing the gravel back across to obscure the edges. The elongate, triangular shape gives the bed an interesting flow.

Once settled, he planted it with *Pinguicula grandiflora* and a number of *Sarracenia* species (*S. flava* var. *flava*, *S. purpurea* subsp. *purpurea*, *S. purpurea* subsp. *venosa* var. *burkii*, *S. minor* var. *okefenokeensis*, and *S. rubra* subsp. *rubra*), and added a few small reeds as complement plants.

Ian lives in the Neath Valley in South Wales, an area known for its high rainfall. This climate, along with the depth of the bog, means he doesn't have to water too often. The area averages a winter low of around 23°F (-5°C), and occasional highs in the summer of 86°F (30°C), although this is a rare occurrence.

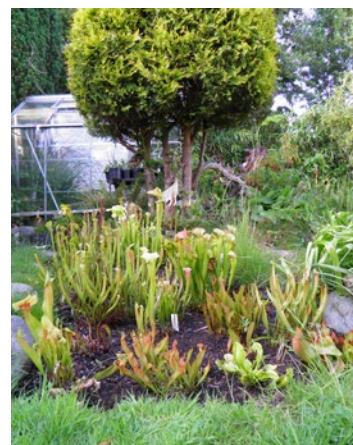
ENGLAND

Mark Griffin has created his bog in a fashion similar to Ian's, lining it with pond liner and filling with peat moss, sand, and gravel. This garden is incorporated as more of a standard flower bed, protruding onto the

Two subspecies of *Sarracenia purpurea* growing together.

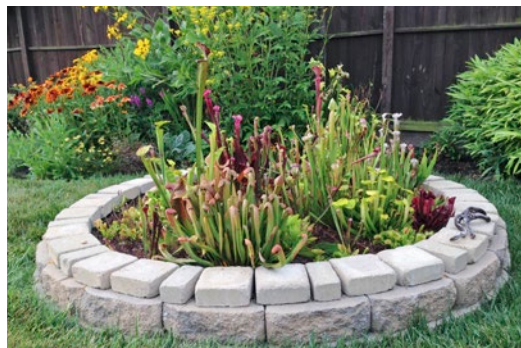
LEFT A general view of Ian Salter's bog garden beside his greenhouse.

Mark Griffin's bog garden becomes another border within the garden.



LEFT Matt DeRhodes's raised bog makes a fantastic feature on the lawn.

RIGHT In winter, Matt covers the garden to protect plants from the worst of the snow. This will also encourage early growth in the spring.



grass and edged with a few rocks to break the rigidity of the liner. He's planted it with a variety of *Sarracenia* species and hybrids. Mark lives in the southern county of Wiltshire, where summers are warm—generally around 68°F (20°C), but occasionally up to 86°F (30°C)—and average winter low temperatures are around 36°F (2°C), occasionally dropping to as low as 14°F (-10°C). The county sees good rainfall all times of year, with occasional snow during the winter.

THE UNITED STATES

Based in Cincinnati, Ohio, Matt DeRhodes has created a raised bed for his plants. This is a more formal feature and sits comfortably on the lawn, where it becomes a prominent element of the garden. Again, he dug down to around 6 in. (15 cm) deep, and lined the bog with pond liner. The three layers of blocks add extra depth, with the liner tucked under the top row. Extra height above ground level also makes close observation easier. This can be adjusted to your own climate; add layers to make the bog higher in warmer climates, and reduce the number in colder areas.

The space created was then filled with peat moss, perlite, and pine needles, and planted with various *Sarracenia* species and hybrids, as well as Venus flytrap (*Dionaea muscipula*).

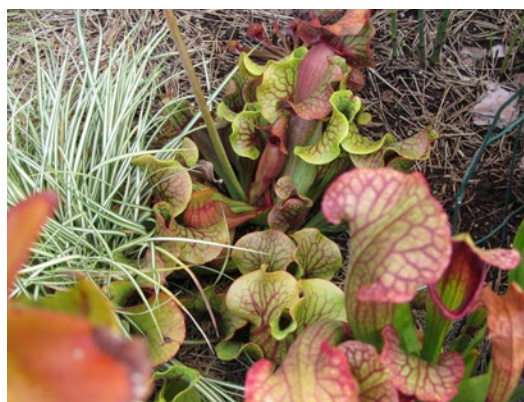
The climate sees a wide temperature span, with an average winter minimum of 22°F (-5°C), sometimes dropping to -10°F (-23°C), and warm summer days averaging 86°F (30°C), occasionally reaching 98°F (37°C).

Matt chooses to cover the bog in the winter months to protect it from the effects of desiccating winds, using a cloth cover held over a frame. This would also serve to encourage early growth in the spring, and can be removed once the danger of severe frost has passed.

SERBIA

Andrej Jarkov lives in Belgrade and manages to grow his plants outside, despite the harsh conditions. The average temperatures there represent something of an extreme, with the summer average 88°F (31°C), the winter average a cold 9°F (-13°C), and spikes well above and below these averages. There is rainfall year-round, peaking in May and June.

Andrej grows his plants in mini container bogs, which are half-buried to protect the roots of the plants from the extremes. These are filled with a mix of peat moss and silver sand, and topped with sphagnum moss. In this setup he plants various *Sarracenia* species and hybrids, and also a few sedges (*Carex*), as well as some small, noninvasive grasses which complement the carnivorous plants. Despite the harsh conditions, he has had *Sarracenia leucophylla* produce a leaf 30 in. (75 cm) in height!



Pond marginals

Carnivorous plants aren't usually thought of as candidates for the margins of ponds, but over the past ten years I've sold many plants—almost exclusively sarracenias—for use in these areas and can report some remarkably positive results.

When one considers the fact that they like their feet in water in a sunny position, they seem ideal for the conditions around many ponds, and certainly make elegant and unusual additions. It is in these environments that I have seen some interesting uses

Even in this extreme environment the plants are happy.

TOP Andrej Jarkov partially buries his containers for added protection in the harsh winter.

of the plants, none more so than Tom Hoblyn's 2009 Chelsea Flower Show garden, which was inspired by carnivorous plants and their vulnerability in their natural habitat. It demonstrated perfectly how the plants can be used both in natural and contemporary settings, though was also interesting for his use of purely natural materials.



Tom Hoblyn's 2009 Chelsea Flower Show garden featured blue *Iris* and *Sarracenia flava* specimens.

I have several baskets of *sarracenias* in my ponds, and they have remained in the water for the past seven or so years, through several very hard winters, with no ill effects. It is simply a matter of planting them in standard pond baskets. The best type are the square ones; they are more stable once in the water, especially for taller plants, which are more likely to sway in the wind.

First I line the basket. I prefer using a piece of ground cover membrane—the sort used to suppress weed growth, because it's UV-stabilized and will not rot in the water—which I puncture a few times with a knife to allow a good ingress of water. The membrane will prevent any small particles of peat moss from escaping into the water. Next, select your plants and consider positioning. If your pond is sheltered, you will be better able to grow the taller species of *Sarracenia*. If it's exposed, choose the lower-growing plants.

For tall plants, use a deep basket and place a few large pebbles in the bottom for stability. You can pot several plants together to make a small display of contrasting

heights and colours. Use a mix of peat moss and perlite in equal parts, though this doesn't have to be exact.

Finally, a layer of washed gravel on the surface will prevent the potting mix from blowing across the water and the perlite from floating up to the surface. Now soak well using a watering can rose, and gently lower the basket into the pond, making sure the plant bases are just above the water surface. The position will need to be along the marginal shelf, or on blocks to raise the height (a small upturned bucket drilled with holes will suffice for this). Inevitable fluctuations in water level are fine.



The best types of ponds are those that aren't overstocked with fish, as they will add too many nutrients to the water. The large koi which are so popular (and large enough to feed a family of six) are somewhat destructive in that they tend to knock baskets over.

Avoid using water that has been treated to remove algae. The best ponds are those of a more natural type—left to its own devices, a pond should clear naturally a year or so after initial filling, rendering methods and potions for clearing the water superfluous.

Plants can be left in the water year-round, and yes, that also means they will freeze in the winter. Being marginals, they are in the shallows, which means that they are in the layer that freezes. They will be encased in ice, and this is fine; there is no need for concern.

The same principle works in a more modern setup; the taller-growing species have a structural elegance that enhances contemporary designs; various suitable containers are available for this purpose.

Another option is floating containers, which carry the benefit of not having to be placed in the margin or on a plinth. These can be planted in the same fashion as a basket, but without the membrane liner, then simply lowered into the water. The surrounding

Mixed planted baskets add unusual colour and form, and work equally well in traditional and contemporary situations.

LEFT A large specimen of *Sarracenia purpurea* subsp. *purpurea*, an ideal species for windier situations.

Floating baskets are ideal where a marginal ledge is absent.



polystyrene floats around the plants, ensuring they remain upright and don't sink. These are ideal for small- to medium-height plants; slightly taller plants can be used if the pond is in a sheltered location.

Outdoor containers

Floating containers are great for ponds; in fact, there are many places where these plants can be grown in containers. The selection of ready-to-use pots is many and varied, and there are also options that require only a bit of adaptation to be suitable as vessels.

Belfast or farmhouse sinks—deep, white, glazed ceramic kitchen sinks—make perfect containers. Since they are watertight (when plugged) and glazed, there is nothing to react with the potting mix and damage the plants. They are also fitted with a handy

overflow regulator, which maintains the water level. They make ideal mini bog gardens and can be planted with any of the cold hardy species.

Bear in mind the positioning before you start. Work in the same way you would with a buried bog, filling the sink with peat moss, or peat moss and perlite, before firming down and filling the basin with rainwater until the potting mix is saturated. Plant as discussed previously.

If your planting is raised above ground level, you can appreciate your plants more easily. It's also a great way to get young children interested, a topic we'll cover later. Of course, it doesn't have to remain above ground, and by burying it you can successfully "grow" carnivorous plants in the ground (as long as they don't dry out).

Let your imagination go. Don't think that you have to own a heavy Belfast sink to create your own mini bog—any container will suffice. It doesn't even have to be particularly watertight, because you can easily line any suitably sized vessel with pond liner and prepare as directed. Remember what I said about concrete containers, however—these will definitely require lining, as will anything metal, due to the acidity of the potting mix and the reaction it can cause.

A simple wooden decorative container fashioned to resemble a half barrel is an ideal container for a sunny patio or deck. It will look great all summer when planted with *sarracenias*, especially if a few colourful hybrids are included that have a longer growing season; their colour will intensify as the autumn progresses.

Plastic containers are often a good choice. They are durable, shatterproof when the kids are kicking footballs around the garden, and long lasting. They can also resemble stone containers, are easy to move if necessary, and have the added advantage that they do not need to be lined.



Oak containers can be used as planters (such as here), or as mini ponds.

LEFT Plastic planters are versatile and won't crack in the winter as some ceramics will.

RIGHT Fibreglass mini ponds are perfect for smaller gardens, and add appeal to patios and decking.



Metal containers have a different look and feel altogether, conveying a clean, modern impression. These are available in various sizes and can be galvanized or powder-coated so they won't rust. If metal pots are sealed, the occupants can be planted directly inside. Alternatively, metal containers can hold other pots, allowing plants to be easily swapped out. Try to avoid the cheap, flimsy versions, as they lack the strength of the high-quality types, especially if you envisage moving the pots at any time—they may be very heavy. These are suitable for both inside and outside use.

Containers do not have to be large in terms of size, or require a lot of effort. Small tabletop displays have the advantage of being somewhat more movable than large troughs, and are great conversation pieces. These can be as small as a ceramic bowl for a single pot, and can be used to adorn patios and tables both outside and in.

A variant on container growing is the use of a mini pond, which can be positioned anywhere suitable, especially where some extra interest is called for. These mini ponds can be planted entirely with carnivorous plants, or with a combination of other aquatics.

Again, a variety of vessels can be utilized for such a project. Oak half barrels offer a rustic feel and work well in a sunny spot in a more traditional garden. Modern containers

such as fibreglass ponds fit with contemporary environments, and are designed for just this purpose.

Both types are perfect for mini ponds. Position the container in its final location—someplace sunny where the plants will receive the light they require—then simply fill with rainwater and plant. In addition to sarracenias, I like to include a dwarf water lily, and some elodea is useful for a year or so, until the water chemistry balances and the algae (which is guaranteed to develop), clears, leaving a healthy ecosystem filled with aquatic life.

At this stage you can either remove the elodea, or at least keep it in check by thinning it out. Once the water clears, the time is right to drop in another carnivore, such as the bladderwort *Utricularia vulgaris*.

IN TERRARIUMS

For many, a terrarium is an ideal place to grow carnivorous plants, especially for anyone not blessed with a greenhouse or garden. Terrariums don't suit all plants, so you will be somewhat limited in the number and range of species you can grow successfully, but this should not put you off.

The first step is to consider what terrariums actually are. Generally, they are a glass or plastic box with a removable lid, or front sliding doors. Their interiors are high-humidity environments. They can be a simple glass tank or a more elaborate piece of custom-made furniture.

The tropical conditions within limit the number of plants you can successfully grow, but do include some of the most desirable of carnivorous plants. Aside from the tropical butterworts (*Pinguicula*), the many terrestrial and epiphytic species of bladderwort (*Utricularia*), a couple of sundew species, and the sun pitchers (*Heliamphora*), by far the largest group in number and stature are the tropical pitchers (*Nepenthes*).

Don't even begin to contemplate growing any temperate species unless the terrarium receives full sun (in which case it will require ventilating) or has very strong artificial lighting, and you are able to move the occupants to cold winter quarters for their rest period. If you are restricted to growing the plants solely indoors, go for those just listed.

There are different types of terrariums available. In the traditional sense of the word, they are sealed glass cases, originally known as Wardian cases because they were

developed during the Victorian era by Dr. Nathaniel Ward. Their purpose was to enable the safe transport of collected plant specimens from overseas, helping the Victorian obsession with exotic plants immeasurably since the majority of those collected previously perished during the long journey back to England.



Planted by Matthew Wagstaffe, this is a perfect example of how a terrarium can become both an attractive and unusual piece of furniture.

The cases were made of steel or wood and glazed to create a sealed environment, which was self-sustaining, as evaporated water could not escape. It simply condensed on the inside walls and ran back down, hydrating the plants within.

Modern terrariums operate on a similar principle, but aren't completely sealed; we like to examine our plants more closely and access is required for maintenance. They can be as simple as an empty fish tank with a lid, or a specifically designed affair with a heated base and lights. While the latter will undoubtedly be more expensive, it will also enable the plants to grow more successfully.

The average room temperature inside a house will be sufficient, especially under lights. Added lights will create the same effect that one sees in the wild, wherein the day temperatures are higher due to the sun, with a distinct drop at nighttime—a phenomenon certainly seen in many tropical regions.

Because of their often elongate shape, and the limited space available, fluorescent tubes or LEDs are the best types of lighting for our purposes.

The terrarium can be planted if the occupants are to remain inside year-round, which will afford an aesthetically pleasing result. On the other hand, planting will necessitate more maintenance, in terms of controlling the rampant advance of mosses and weeds, which will thrive as readily as your plants. It will also further limit the range of plants you can grow, because different species have different soil requirements.

If you choose to plant your terrarium, here's how to begin. Start by adding and leveling 2 in. (5 cm) of clean, washed horticultural sand in the base. Next add 4 to 5 in. (10 to 12 cm) of your preferred potting mix—an equal blend of peat moss and the same sand will be ideal. Arrange your plants on the surface until you are happy with the layout and balance, then remove them from their pots and plant. Maintain a water line of at least

an inch (2½ cm), which will be visible in the sand layer. The addition of props will add an extra level of interest, and sphagnum moss can be placed on the surface to grow (though this will need to be kept in check as it will outgrow some of the smaller species).

If this is to be a sub-tropical terrarium which will witness an average temperature of around 75°F (24°C), you can successfully grow *Cephalotus*; tropical, pygmy, and sub-tropical sundews (*Drosera*); terrestrial and some epiphytic bladderworts (*Utricularia*); and (with a slight adjustment to some of the soil) a couple of the sun pitchers (*Heliamphora*).

Although this temperature will suit some of the higher-altitude tropical pitcher plants (such as *Nepenthes*), the soil will not—one of the annoying limitations we mentioned about terrariums. An alternative, and one which will undoubtedly widen your range, is to grow plants in their pots and then to simply place the pots in trays of water within the terrarium. This allows you the freedom to add and remove them as required, and means they can also be taken out for closer inspection.

This method of tray watering will give you far greater control over the amount of water a plant receives, and in the case of *Nepenthes* plants, which do not like to stand in water, it is a logical way of growing the widest range of plants possible. In this environment, you can grow all the genera listed earlier for planted terrariums, with the addition of some smaller-growing species of *Nepenthes* and all the *Heliamphoras*. Although you will need to take care watering, the high humidity within will ensure that the length of time between refills is much reduced.



The potted terrarium is more practical if you like to remove your plants for closer inspection. This example belongs to Vincent Fiechter from Geneva, Switzerland.

The same method can be utilized for a heated terrarium, often referred to as a “lowland terrarium.” *Nepenthes* is loosely divided into two groups with regard to cultivation: highland and lowland. The highlanders are found in the wild at altitudes over 3280 ft. (1000 m), whereas the lowlanders are found under this threshold.

Temperature drops with increasing altitude, approximately one degree Fahrenheit (six-tenths of a degree Celsius) for each 328 ft. (100 m), and as such, the temperature in a tropical climate is considerably higher at sea level than it is on a mountain at, say, 13,213 ft. (4000 m). By creating this differentiation, we can accommodate plants from different altitudes, though they will need to be grown separately.

In a lowland terrarium, the temperature needs to be raised, with a nighttime minimum of 75°F (24°C), and a higher daytime temperature—which is easily achieved with the addition of artificial heat.

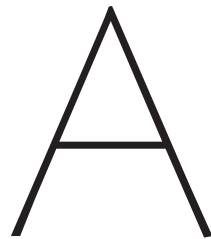
In this hot and humid environment, you will be limited further in terms of the range you can grow, but if your particular penchant is for lowland *Nepenthes*, then this will be ideal. You can also add a few tropical bladderworts (*Utricularia*) and tropical sundews (*Drosera*) for extra interest.

There are a couple of methods of heating the terrarium. An aquarium heater (available from most pet shops) submersed in a bath of water will not only heat but also humidify the terrarium. Keep a close eye on the bath to ensure it never dries out. Alternatively, a flat heat mat of the type used for heating reptile and amphibian vivariums is ideal. These are relatively inexpensive and available in a variety of sizes; simply select the size that best fits under the terrarium without protruding from either end. If you are going to use one of these for the heat source, you will need to stand the terrarium on an insulated surface, such as a layer of polystyrene or foam rubber, to ensure the heat is concentrated upward, not down, to increase efficiency.

The addition of a thermostat to control the heat and a timer to control the lights will give you a fairly self-sufficient unit in terms of the day-to-day environment. Just keep an eye on water requirements, and perform occasional surgery on those plants whose intention it is to escape their confines and join you on the sofa.

Whichever type of terrarium you choose, always ensure that the plants you add are free of pests and diseases, which will spread through your other plants like wildfire. More on pests and diseases a little later.

YEAR-ROUND CARE & MAINTENANCE



little about annual maintenance. Apart from keeping plants wet and sunny in the summer and adhering to the three golden rules, most carnivorous plants require very little

in the way of everyday care. In the autumn, deciduous species will need tidying up. Annual clean-up can seem a chore, especially if you have a large number of plants. But

alas, it is unavoidable—an essential aspect of the cultivation of carnivorous plants.



Evergreen species of *Drosera* (here, *D. slackii*) can, over time, develop a substantial pedestal.

Each of the two most prominent genera has its own general maintenance needs. *Sarracenia* plants die back at differing times over the autumn and winter. Once the leaves have browned off sufficiently, the old growth must be removed—a simple process we'll look at in more detail later. Those species of *Drosera* that die back to their roots or form winter resting buds can simply be cut back with scissors, removing the dead growth. The evergreen species, such as *Drosera capensis* from

South Africa, develop a skirt of dead leaves around the base of the plant, which helps support the upright stem and can be left intact—as can the old leaves under the rosette species. Over time, the dead leaves form a pedestal of old growth under the live leaves.

TOOLS

If you are fortunate enough to possess a substantial number of plants, it is wise to avail yourself of appropriate tools for the job. Good-quality pruning shears (secateurs) will pay dividends, and the extra investment will give you years of service around the entire garden.

Sharp shears of the type used for topiary are, for me, a real asset, saving me many hours. They self-sharpen as they're used, with the edges of the blades rubbing together, enabling you to cut through a large number of wiry sarracenia leaf bases in one cut—great for larger specimens, and for saving time.

Long tweezers can be extremely useful for removing dead leaves from sticky-leaved plants, for plucking out seedlings, and for any one of a number of tasks where large or cold, numbed fingers just won't suffice. Again, go for quality—they will be much sturdier. Mine are from a bonsai-growing nurseryman friend and have a flattened, blunt blade at the top which is ideal for making holes in the potting mix when transplanting.

A sharp pair of scissors is always helpful for more delicate pruning of fine plants, and some very good ones are available from specialist bonsai growers. All the tools you use



should be kept in good condition, cleaned regularly to eliminate any risk of cross infection, and sharpened when necessary. Specific sharpening stones are available for pruning shears, and they should be used regularly to ensure you are performing clean cuts with minimal effort.

Cleanliness is paramount, especially as you will invariably use your tools around the garden. After each use a quick wipe with disinfectant will sterilize the blades, and a good rub with one of those baby wipes will remove any sap residue. Some advocate the use of a strong bleach solution, but this is poisonous to all green plants, so I avoid it. A squirt of oil after cleaning will prevent any rust developing on the metal surfaces, and keep the moving parts lubricated.

A large plant such as this *Sarracenia minor* is best tackled with topiary shears.

LEFT Always select high-quality tools.

PESTS AND DISEASES

It can seem incongruous to learn that carnivorous plants can be prone to pest attacks when you consider their nature, but like any group of plants, there is a veritable army of insect warriors on the march. The reason the plants cannot defend themselves is that the pests usually attack developing leaves. The pests are also usually very small and elude capture.

There are differing methods of control which I'll suggest, but first a mention of spraying. This is a controversial subject, but most insecticides are fine to use on carnivorous plants, though some care or experimentation should be used with glandular-leaved plants such as the sundews and butterworts. There's a fine balance here. I find a close eye and a reactive approach work well, rather than overspraying and risking the development of a local resistance to the chemicals. This can also be avoided by changing the insecticide on a regular basis. Some offer a systemic cover, in which the active ingredients are taken into the plant's system, where they remain and offer a period of protection, usually around six weeks. I feel these claims are a little overstated, so a keen eye is the best way to prevent a pest from gaining a foothold. Ready-to-use varieties are ideal and convenient. If you are using a concentrate, mix it according to the manufacturer's instructions. The available range changes as it is discovered that chemicals which have been used widely are in fact somewhat dangerous to health or the wider environment, but here are a few currently in use. I have listed the active ingredient rather than the proprietary name, which varies from country to country.

ACETAMIPRID A good all-around insecticide sold by Scotts under the name Bug Clear Ultra in the UK and Ortho Bug-B-Gon: Systemic Insect Killer in the United States. Available as a concentrate and a ready-to-use spray, and again I've used this on all the genera covered in this book.

THIACLOPRID Another good insecticide. Also available as a ready-to-use spray and concentrate, this is a systemic product, and I have used it on all the genera covered in this book.

ORGANIC SPRAY There are a few organic insecticide sprays available which contain fatty acids. These have their benefits, especially where pets and children may be in close proximity. The way they act ensures no risk of localized immunity to the active ingredients. Bayer manufactures a good example which seems to be safe to use on dionaeas, droseras, and sarracenias.

BIOLOGICAL CONTROLS Biological controls are available for many greenhouse pests, but their employment is rarely justified for a small collection unless the infestation is severe. There is also the very real risk of plants catching "good bug" predators, especially if they have a penchant for the nectar the plants produce.

FUNGICIDES Here's where the old adage of an ounce of prevention being worth a

pound of cure certainly rings true, as there appear to be no currently available fungicides which will prevent grey mould (*Botrytis*). Remember my earlier comments about good air circulation.

Pests

ANTS

Ants are rarely an issue themselves. Quite the contrary, it's quite a sight to see a long trail of them moving along the benching and up a *Sarracenia* pitcher, where they fall one after another into its depths. However, their habit of “farming” some pests can be a nuisance. Plants grown outside are not usually bothered by their nesting habits, if the potting mix is kept wet enough.

APHIDS

There are a number of species of this all-too-familiar garden and greenhouse pest. They are typically $\frac{1}{25}$ to $\frac{1}{8}$ in. (1 to 3 mm) in length and a green or black colour, often forming a large colony which can clothe entire shoots. Their success lies in their prolific breeding habits, meaning that an infestation can take hold surprisingly quickly. They are sapsuckers, feeding through a sharp stylet which they insert into a plant's vascular system to feed, causing disfigurement to the emerging leaves—generally the first sign that they have attacked your plants. Another side effect is sooty mildew (more on this later), the by-product of ants which will “farm” aphids to feed off the sweet exudates they produce. A more sinister side effect is the transference of plant viruses while aphids are feeding, which although very unlikely with carnivorous plants, is still worth bearing in mind. A small number of aphids can simply be squashed between the fingers, but if you feel squeamish doing this, or if the infestation is heavy, you can either submerge the whole



Deformed leaves, the sign of aphid damage.



Although not usually a major pest, caterpillars can cause severe damage, as here on a leaf of *Nepenthes burbidgeae*.

TOP Birds are an occasional pest, especially when they learn a free meal is to be had in the guise of insects caught within *Sarracenia* pitchers.

plant in a bucket of rainwater for twenty-four hours, which will drown them, or spray with an insecticide.

BIRDS

Not your usual suspects, and I can remember only a couple of years when an enterprising bird learned to rip the *Sarracenia* pitchers open to retrieve a free meal (coincidentally, it happened while writing this book). Thankfully, the trick appeared to be forgotten the following season. They can be a problem when trapped in the greenhouse and disoriented, flying at the glass to escape and knocking plants and pots over. Some birds seem more intelligent than others. Wrens frequent the nursery on a regular basis, flying around and through, completely unfazed by my presence. Blackbirds and blue tits, however, are carefully ushered out.

If you live in a rural area as I do, be aware of pheasants. They are without doubt the stupidest of all creatures and can cause considerable damage, both to plants and bench linings, with their sharp claws. They do, however, roast well.

CATERPILLARS

Caterpillars are another of those casual pests. Our plants aren't their usual diet, but occasionally they bite the soft young growth. Random holes and orange-coloured excrement announce their handiwork, often in the autumn for some reason, when the last pitchers are produced on the *sarracenias*, and when the damage is rather superfluous due to impending dieback. Again, manual removal is usually all that is required; insecticidal intervention is not normally needed.

CHILDREN

Carnivorous plants are the perfect subjects for introducing plants to children, and I cover some educational ideas in the last chapter of this book. However, in the greenhouse, especially unsupervised, they can amuse themselves by closing all your flytraps, or checking to see if the *Nepenthes* lids move (they don't—unfortunately, they snap off), or running curious fingers through your sundews. This is all fine if you don't mind their hands-on approach—there will be no long-term damage. But having once been setting up my display at a flower show, only to find my son doing all of the aforementioned to my display plants, I can fully appreciate the potential carnage and horror! (I should add that he was only six or seven at the time.) Joking aside, while kids are young, do allow them to touch the plants in a controlled situation, explaining the hows and whys of such interesting living things.

MEALYBUGS

Another soft-bodied, sap-sucking insect which can be persistent and requires a careful regimen of treatment to eradicate. There are many species, but typically mealybugs are oval-shaped, segmented insects to around $\frac{1}{8}$ in. (5 mm) long, a whitish grey in colour, with two filamentous spurs on the rear end. Their preferred carnivorous hosts in cultivation are *Sarracenias*. Mealy bugs exude a white, waxy material, which resembles cotton wool, in which they hide and lay their eggs. As they feed, they also excrete a sweet material known as honeydew, which, as with aphids, can lead to sooty mildew. Clusters of mealy bugs can be found at the base of leaves, and their population increases in the autumn, although they are active during the entire growing season. Control can be tricky; the key is understanding their life cycle, which takes approximately thirty to forty days to complete. Life



A mealy bug on a *Sarracenia* pitcher leaf.

TOP Allow kids a supervised, hands-on approach to your plants. Get them interested early. Balls and associated projectiles are the primary cause for concern.

cycles often overlap. A spray with a suitable insecticide will remove any live insects, but will not kill the eggs, which will continue hatching. Two or three subsequent applications at two-week intervals should solve the problem. It is this phenomenon that has prompted the assumption that they are difficult to eradicate.

PITCHER PLANT MOTH AND PITCHER PLANT RHIZOME BORER

These two pests are confined to the natural range of *Sarracenia* in North America, and are (thankfully) absent in the UK. The caterpillars of the pitcher plant moth species consume the plants' pitcher walls, causing them to collapse and topple over. The rhizome borer, as the name suggests, eats into the rhizome, leaving a trail of orange-coloured droppings. (Rhizomes are swollen, horizontal underground stems that serve as plant storage organs, from which shoots and roots grow.) Both can be controlled by a suitable insecticide and prompt removal of infected growth.

RABBITS AND DEER

Rabbits are by far the most troublesome and destructive pests I encounter. These insidious creatures dig up or eat just about everything I plant, from *Sempervivum* and even *Agave*, to roses. They strip the bark from trees and shrubs, and treat my garden as a vegetarian smorgasbord. However, they do leave the many *Sarracenia* plants I have outside alone, and I have never seen a rabbit showing the remotest interest in them. I take my revenge on these mammalian menaces, and eat them occasionally, which provides a degree of satisfaction. Like rabbits, deer appear to show a similar disdain for our plants and are therefore not a concern.

RED SPIDER MITES

These tiny red-coloured mites, which are not spiders, are only $\frac{1}{50}$ in. ($\frac{1}{2}$ mm) in length. They are serious crop pests in some countries, and are usually noticed when they have produced a substantial colony within a silk tent. They suck the contents from individual cells, causing brown spots and seriously impeding a plant's photosynthetic abilities. Although a greenhouse pest, red spider mites prefer somewhat drier conditions than carnivorous plants, so are less likely to be encountered than other pests. They can be destroyed by an appropriate insecticide/miticide (check the label to be sure).

RODENTS

Rodents will generally appear in the autumn, a greenhouse being ideal winter quarters—especially if it's a heated enclosure. In a well-maintained house with little in the way of clutter on the floor, they are unlikely to arrive. In the nursery they are a problem, and an autumnal bait keeps them at bay. Very occasionally, mice and rats will eat the rhizomes of *sarracenias*, though I have only seen this once in the nursery, a number of years ago.

SCALE INSECTS

There are many species of the sap-sucking scale insect, though the typical greenhouse variety is small, flat, and oval, with a light tan colour, to $\frac{1}{8}$ in. (5 mm) in length. They are not as prolific as mealy bugs, but their treatment is the same. They too produce a sweet exudate which encourages the growth of sooty mildew.

SLUGS AND SNAILS

These mollusc pests aren't usually problematic. They seem to graze casually on the likes of *sarracenia*s rather than do any real damage. However, they do have a penchant for, and can be destructive to, the soft, fleshy leaves of butterworts (*Pinguicula*). Active in the cooler temperatures of night, they nibble away while you have your feet up, leaving a trail of destruction and excrement over your pots. If you have a problem, a trip to the greenhouse at night will catch them out and about, so they can be manually removed. A few slug pellets on the floor of the greenhouse should stop any new arrivals, but be careful not to allow other animals or children to come into contact with the pellets.

SQUIRRELS

Like birds, squirrels can be destructive if they feel trapped in a greenhouse. They do like to bury nuts, though, and in the spring, I always find a number of hastily buried walnuts in pots. A word of warning: never corner a squirrel.



Scale insects are usually found in small numbers, here seen on a *Heliamphora* pitcher.

THRIPS

Thrips are small, winged insects (though poor flyers), around 1/25 in. (1 mm) in length and black in colour. They will eat the surface layer of leaves, mainly species of *Sarracenia* and *Darlingtonia*. Control them with an insecticide.

VINE WEEVILS

This serious garden pest has become very prevalent in recent years. The issue isn't the 1/2-in.- (1-cm-) long black adults which nibble leaves, producing characteristic semi-circular notches. It's the pale larvae, which are of a similar size and consume the roots, destroying the plants—in our case, mainly *sarracenias*. Fortunately for fanciers of carnivorous plants, the larvae easily drown, and the adults cannot swim, so a good depth of water maintained under your plants will act as an effective barrier. This is an important consideration for plants kept outside, where there should be either a barrier between the edge of the water tray and the container housing the plants, or a high water line to ensure the potting mix is saturated.

Diseases

GREY MOULD

Generally regarded as the nemesis of carnivorous plant growers, grey mould (*Botrytis cinerea*) is a fungal infection that attacks dead plant growth, predominantly on *sarracenias*. This is definitely a case where prevention is better (and easier) than cure. The removal of such material and good air movement virtually eliminates the risk of it developing.

If it does occur and has spread to live growth, you will see that an entire growth point (crown) has been infected. If there are a number of growth points on the plant, then you have plenty of material and don't need to worry about losing the plant. If it is a single-crowned plant, you have a problem.

The first thing to do is remove the affected growth, which involves cutting the point off, leaving a stub of white rhizome (the rhizome can very rarely be flushed pink). If the rhizome is brown, it is still affected and further surgery is required until you reach clean material. Wipe the pruning shears with disinfectant after each cut to ensure you do not infect healthy tissue.



A large plant can usually breeze through this kind of treatment, but a single-crowned individual may be left as a rhizome cutting. Other genera are rarely affected in the same way, but a watchful eye is warranted. Interestingly, *Botrytis* is the historical “noble rot” referenced in winemaking, describing when grey mould covers grapes and increases sugar levels, accounting for the smooth sweetness of dessert wines.

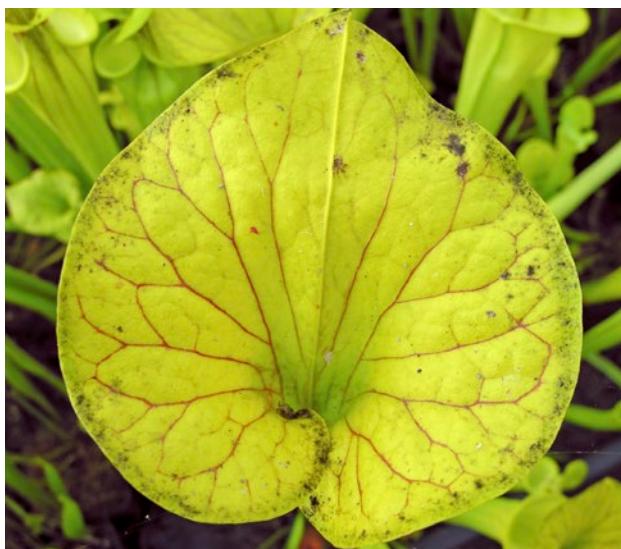
Remove the growth point so that only white tissue remains.

LEFT Grey mould attacking a *Sarracenia leucophylla* specimen. Note how the entire growth point is affected.

SOOTY MILDEW

I’ve mentioned sooty mildew a few times already, as it’s associated with some of the pests listed previously. The truth is, it’s not all that bad, and is often a handy indication of an infestation of some sort. It is found on most *Sarracenia* plants by mid- to late summer, because it also develops on the nectar produced by the plants, even in the wild.

It manifests as a black deposit over the leaf surface, and only becomes detrimental if it covers a substantial area and can affect a plant’s ability to photosynthesize. If it appears heavily over the base of the plant (again, especially species of *Sarracenia*) it is almost certainly the result of a pest attack. When it shows up on the lids and throats of the pitchers (and it will), there is usually no cause for concern. If it bothers you, remove with a soft, wet cloth.



You can see the pattern of sooty mildew following the nectar glands around the edge of this *Sarracenia flava* lid.

RIGHT Sooty mildew will also colonize the leaves farther down. Here you can see it at the base of *Sarracenia minor*. This small amount is quite normal, especially later in the summer.



FEEDING

Feeding may seem a little at odds with our subject matter—after all, why would we need to provide food for plants so adept at feeding themselves?

The answer lies in supply and demand. In the conservatory during summer months, there is no paucity of insect life on hand to satisfy the requirements of our plants. However, in the confines of the terrarium, or for a not insubstantial number of winter-growing plants, things are a little different. There are times when feeding is recommended, though it is not absolutely essential. Plants will still grow, just not as quickly and vigorously as when given a food source, so there are definite benefits. There is also the issue of frequency. Perhaps it's the erroneous animal link that people attach to carnivorous plants, but there is an assumption by many that the plants need feeding two or three times per day. But these are not animals and a long period without food will do them no harm. If your plants are outdoors or in a greenhouse/conservatory, they will at times catch a huge number of insects and should be left to their own devices.

Let's first look at what *not* to feed your plants. I have heard from countless people what they have fed their plants—usually followed by a comment like “. . . and then the

leaves all turned black.” So here are a few examples of things you *don’t* feed carnivorous plants, taken from anecdotal reporting.

Ham and other processed meats, including hamburger

Cat food

Chocolate and other forms of confectionary

Cookies

Dog food

Lego bricks

Milk

Although some of these contain nutrients beneficial to the plants, they do encourage leaves to rot, especially if given in larger-than-necessary quantities. The best policy is to avoid feeding carnivorous plants anything other than insect matter.

In a terrarium, a few insects every couple of weeks will be more than sufficient, administered directly to the traps. Don’t be tempted to overfeed them in the hopes that you’ll find Audrey II the following morning; you will simply succeed in rotting the leaves in the high humidity and creating an unpleasant smell. The size of the trap has a direct correlation to the intended size of the prey, so don’t attempt to feed a hornet-sized insect to a small sundew.

There have been many suggestions over the years to feed carnivorous plants with dilute concentrations of proprietary plant foods, something I’ve never found to be necessary. To keep things simple, let’s disregard this debate. The best items to feed your plants are those handy, self-contained insects which they are designed to consume, and these can be live, dried, or even tinned.

With live insects, the cheapest and most convenient method of gathering is to wander around the garden in the darkness of evening, looking under stones and on the undersides of leaves, collecting whatever you find. A good range of insects can be captured in this way, and under cover of darkness you are less likely to be seen by your neighbours, who will already have their reservations about you, since you grow carnivorous plants.



Some dieback of traps is to be expected, especially older leaves which have reached the end of their lifespan.

Any insect will suffice, the plants are not selective about what they eat—though avoid earthworms, because they have the ability to escape most traps. In pitchers, they will produce a nasty smell.

Woodlice (sow bugs), flies of all denominations, beetles, caterpillars (though these

can literally eat their way out of a trap), wasps (best avoided if you don't want sore fingers), spiders, and small grubs are all suitable. They can be fed directly to your plants. Remember to match the size of the prey with the size of the trap—insects should be large enough to be of value to the plant, but not so large that they kill the leaf.

If you prefer not to stalk around your garden in the darkness, you can always buy insects. A wide variety is available from reptile suppliers online. The most convenient is the common brown cricket, *Acheta domesticus*, which is bred extensively as a live food. They are available in a variety of sizes, known as instars (sizes go from first instar to second instar, and so on, as they moult and become progressively larger).

The biggest challenge is catching them in the box in which they are supplied. Here, a pair of long tweezers will assist greatly. A word of caution: if you grasp one by a back leg, they will often detach that leg and hop away, usually across the living room floor, where they become difficult to recapture. I well remember being in trouble for just this misdemeanor as a child (when I kept tropical frogs). Adding insult to injury, my mother had a strong aver-

sion to crickets! Placing the crickets in the fridge (not the freezer) for ten minutes will slow them down and make them easier to handle.

Grasshoppers are also available in a variety of instar sizes, but have the disadvantage of being able to jump great distances, making them more difficult to round up in the house.

Freeze-dried insects are a very convenient food for sticky-leaved plants and I use dried bloodworm, which is the larval stage of a midge, for feeding my winter-growing sundews. Dried bloodworm is also ideal for smaller terrarium plants.

A range of canned insects is available in some countries, though not in the UK. These are suitable, but once the can is open, its contents need to be used quickly.



Naturally caught insect prey in *dionaea* leaves.

TOP Suitable insects for our plants. Essentially, if it moves, it's fair game.



COMMON CARNIVORES FOR EASY GROWING

Now that you realize just how easily you can grow carnivorous plants, you have no excuse not to do so. In this chapter, we'll look at six genera, and when appropriate, cover every species they contain, or a

Close-up of a mature cobra lily in its natural habitat in Oregon.

selection of species. The suggestions are not exhaustive, though—there are over a thousand carnivorous plant species in total. The sundews (*Drosera*), for example, contain more than 200 representatives—too many to include here.

In the cultivation sections, when possible, I have included the standard USDA hardiness zone into which each genus and/or species fits (<http://planthardiness.ars.usda.gov/PHZMWeb/>). These guidelines take into account annual average minimum temperatures. This is designed as a general guide, so there will be other factors at play. Earlier I described how individual microclimates can vary, literally between neighbouring houses. When considering plants that are grown exclusively outside, variables such as winter sun, or lack thereof, can also affect a plant's hardiness.

I gauge the hardiness based on my own observations and experience over the past thirty-five years. I hope this will enable you to make informed decisions as to which plants will be suitable for your particular region. With each genus (and sometimes individual species), we will look at the requirements for cultivation and the various methods of propagation.

Darlingtonia

COBRA LILY

The genus *Darlingtonia* contains just one species, *californica*, which we know as the cobra lily and which is found in the same family as *Sarracenia* and *Heliamphora*. Native to the mountains of California and Oregon in the western United States, the cobra lily is without doubt the most sinister looking of all carnivorous plants. Well deserving of its epithet, with its turning, serpent-like pitchers, this is a plant that is guaranteed to attract attention wherever you choose to grow it.

The cobra lily can still be seen in vast colonies in the wild, due to its preference for wet seeps in remote mountainous locations. It prefers sphagnum bogs and is also found extensively on serpentine substrates. Serpentine refers to soil that is naturally low in



A large *Darlingtonia californica* colony in habitat, Oregon.

essential nutrients such as nitrogen, potassium, and phosphorous, but high in heavy metals which are poisonous to many plants. So, the cobra lily can colonize these areas unhindered by competing vegetation. The wet nature of both sphagnum bogs and substrates also serves to impede the growth of other plants.

In habitat, the conditions witnessed by the plants can be harsh; winters can reach temperatures as low as 5°F (-15°C), with frequent snow. In summer, the temperature can reach 80°F (27°C), and with little shade from surrounding vegetation, the plants are adapted to tolerate a high light level.

Darlingtonia californica is a clump-forming herbaceous perennial. Herbaceous means it dies back during the winter. Perennial means it lives longer than two years. It is also stoloniferous, which means it has the ability to spread by means of stolons, or runners, in the same way a strawberry plant does. By doing this, plants can form large clumps over time, the resultant divisions each a clone of the original parent plant and hence genetically identical.

It produces two types of leaf. The first is a juvenile type for the first two to three years of life, which is in effect a small tubular leaf to around 2 in. (5 cm) in length, open at one end with a long spur.

Next, the plants produce their characteristic serpent-like leaves, or pitchers, and there are two distinct types of these as well. When young, the leaves are short, 3 to 4 in. (7½ to 10 cm) in length, and are held semi-erect, often with the forked tongue touching the soil, no doubt to guide crawling insects into the pitcher mouth. Mature pitchers are tall and upright, up to 3 ft. (90 cm) high in the wild, occasionally taller if shaded. As they emerge, they face inward toward the centre of the plant, turning around 180 degrees as they develop. By the time they open, they face outward. The first leaf to open is always the tallest; subsequent pitchers are progressively smaller as the season continues. The pitchers are an attractive apple green when they open, fading to a yellow-green. Some forms display varying amounts of red in strong sun.

As with all carnivorous plants, the cobra lily demonstrates a remarkable level of engineering in its design. Once open, the dome at the top of the leaf inflates and the trap is ready to catch its prey. Nectar is secreted through cells on the tongue, which also acts as a convenient landing platform for flying insects. Bugs follow the trail toward the mouth of the leaf, where there is a concentration of nectar. The mouth has a margin which is



rolled and protrudes inward, resembling the entrance of a lobster pot. Once the insect enters, it finds itself surrounded by translucent windows, or fenestrations, which fill the dome with light.

As caught prey attempts to escape, it invariably loses its footing on the waxy internal surface and falls downward into the pitcher tube. To prevent escape, downward-pointing hairs cover the lower two-thirds of the tube.

The leaf is partially filled with water, which the plant secretes and regulates as there is no possible means of rain entering. It is within this pool that the insects drown. Unlike most other carnivorous plants, the cobra lily does not secrete digestive enzymes, relying rather on bacterial breakdown for the assimilation of nutrients.

Like its cousins in the genus *Sarracenia*, *Darlingtonia californica* flowers in the spring, though the emerging bud is produced, sheathed in protective bracts (leaf-like structure often found on a flower scape), in the autumn after the final leaf opens. It sits at the plant base until the advent of warmer weather. The rather brittle flower stalk reaches a

A cross section of a *Darlingtonia californica* pitcher. Note the rolled mouth, forming something akin to a lobster pot.

LEFT The juvenile pitchers of *Darlingtonia californica* bear little resemblance to those on the adult plant.

A favourite spring sight, the lantern-like flowers of *Darlingtonia californica*, illuminated in the morning sun.



height of up to 30 in. (75 cm), and has at its apex a single flower which hangs downward like a small bell.

It is a unique flower structure like no other: five bright green, narrow sepals to about 1½ in. (4 cm) surround another five petals of slightly shorter length, which are wider and pinched a little before their tips. These are held together so that the pinched sections align to form five openings, allowing pollinators access. The petals are a bright red colour, streaked longitudinally with translucent orange-green lines. These flowers glow like small red lanterns when backlit by the sun—a wonderful spring sight.

Inside the flower there is a large green ovary, ringed at the top of the structure by pollen-releasing stamens. At its base is a five-pointed, star-shaped receptive stigma.

Once pollinated, the petals fall away, leaving the sepals and the green ovary, which swells and gradually lifts from its hanging position to become upright. When the seeds are ripe in the autumn, the seed head browns and splits open for them to be shed. The



split head acts as a shaker, throwing the seeds away from the parent plant in the wind, like a poppy.

In the autumn, plants cease their growth but retain their leaves through most of the winter period, dying back and looking rather sorry for themselves by spring. As flowers and new shoots emerge, old pitchers can be removed.

It is a fairly variable plant in terms of stature and colour, but only one variant has been formally named: *Darlingtonia californica* f. *viridiflora*. This unusual plant lacks the red pigment anthocyanin, which is found in the standard forms. The name *viridiflora* means “green flower,” and not surprisingly, the bloom is lime green with green petals. It was initially given cultivar status as *Darlingtonia californica* ‘Othello’.

Darlingtonia californica seed pod and seed.

LEFT Cobra lily flower with the petals removed to expose the pale yellow anthers at the top of the structure and the star-shaped receptive stigma at the bottom.

CULTIVATION

Given the natural habitat of the cobra lily, you would expect these plants to be tolerant of high temperatures in the greenhouse or conservatory—and you would be quite wrong. Instead, they favour areas with water flowing over and through the roots (which has a cooling effect) and some consideration will need to be given to this requirement. If you can mitigate the effects of the roots overheating, then it’s likely you can grow this plant in

the greenhouse or outdoors. The tray method, in which plants stand permanently in rain-water, is ideal. The preferred position is in full sun, but in contact with a cold base, such as the greenhouse or conservatory floor. The best specimens I grew in a greenhouse were planted in one of those large plastic boxes, under which I positioned a similar-sized box full of water. I circulated the water by means of a small pump. This enabled the plants to enjoy the full sun and heat, but prevented the roots from overheating.

There are alternatives to this elaborate setup. You could position your plants so their pots are obscured by others and prevent the sun from overheating the pot walls. You can also stand them in trays on the floor of the greenhouse under the staging, or in the conservatory. This will give you surprisingly good results, as the coolness of the floor helps prevent unnecessary heat build-up.

Don't be afraid to allow them some shading, if necessary. Unlike *Sarracenia*, the leaves are tubular to their base and, structurally speaking, are stronger and have greater stability. Plants kept in a little shade are less colourful and a bit taller, but just as vigorous and effective, which is advantageous if your greenhouse becomes excessively hot.

A sunny windowsill in the house is also ideal, where the plant can be stood in a glazed ceramic container or something similar. This will also minimize the effects of overheating and will look better than a bland pot standing in a saucer. Just bear in mind its winter requirements.

Darlingtonia californica is an ideal candidate for cultivation outdoors in Zone 7. It is especially well-suited to planting in either a container or a bog garden, or used as a pond marginal. An interesting effect can be achieved by planting them in a trickling waterfall, replicating their natural preference. With a little thought and ingenuity, not to mention a pond basket or two (which may need cutting down), you could easily create a mossy planter of rearing cobras.

There are a couple of options for potting mix. Traditionally it was stated that plants grew best in pure sphagnum moss, which is fine, but you will find that the moss in the lower portion of the pot will gradually decay and smell. I prefer a 50/50 mix of peat moss and perlite (you can increase the amount of perlite if you like, to 70/30), but add a layer of sphagnum on the surface. This can be live or dried; it will soon regenerate and form an emerald green carpet under your plants. Be aware though: the birds will also appreciate your moss.



In a greenhouse, the plants retain their leaves through the winter months, dying back in the spring as flowers emerge. But those outside generally have their pitchers removed by the ravages of frost and snow. Cut the leaves off once they have died back.

Being a plant from temperate regions, it requires a cold dormant period—either outside, where it will withstand temperatures from 14 to 5°F (-10 to -15°C), or in a cold greenhouse. Do not leave this species in the house or in a heated environment over the winter, as you will see a drastic decline in growth the following season, and an untimely death. Move it somewhere cold from October until February.

PROPAGATION

There are three methods of increasing your cobra lily stock, all of which are easy. The most straightforward is by division, in which you take a large, mature specimen and carefully break the individual growth points apart, ensuring each has a few roots.

This must be done in the early spring, before flower stems are 2 in. (5 cm) in height. In fact, if stems are present it is best to remove them on plants you are dividing. Pot the individual plants in the peat moss/perlite potting mix mentioned, and treat as adult plants.

This is the ideal time to divide many plants, for a couple of reasons. Temperatures are generally cool and the sun is far from its strongest, allowing the divisions to settle

A mature cobra lily without its pot and potting mix, to show the structure. The plants form at the end of stolons, making them easy to remove without breaking apart the main plant, though you can also split this plant up if you wish.

LEFT Individual stolon divisions removed. A section of the stolon on each plant has been retained, from which the initial roots are produced.



Its distinctive pitcher means *Darlingtonia californica* needs little in the way of formal introduction.

and root through without being placed under unnecessary stress. This timing also allows plants a full season to re-establish prior to the next winter.

Since these are stoloniferous, you will soon notice that a container of these plants begins to expand and multiply. Stolons are formed from the base of the plant under the soil surface; in potted plants, these are often found circling the pot several times before rising to the top and forming a new plant.

Stolons can be over 2 ft. (60 cm) long, and often have roots along them. These sections can also be used for propagation, when cut into at least 2-in. (5-cm) lengths and potted. Place sections at the soil surface and keep them shaded until small plantlets appear.

The final propagation method is by seed, which was discussed in the chapter on cultivation.



Dionaea

VENUS FLYTRAP

As with *Darlingtonia*, there is just one species in the genus *Dionaea*: *D. muscipula* (Venus flytrap). It is placed in the same family as the sundews, the Droseraceae. This small herbaceous perennial is usually the first stop on the road to a deeper fascination with carnivorous plants; in fact, its popularity was almost its downfall, when millions of plants were stripped from their fragile and small natural habitat to satisfy the needs of the market from the 1950s until the 1990s. This practice has now been reduced (thanks to mass

Dionaea muscipula
plants in the wild
with the sundew
Drosera capillaris.

tissue culture propagation, rendering the removal of plants from the wild unnecessary) but not ceased entirely. It is estimated that there are now only a few tens of thousands of plants in the wild; with habitat destruction, the collection of plants, seeds, and fire suppression (naturally occurring fires are nature's way of clearing competing vegetation), the odds appear to go against the long-term survival of *Dionaea muscipula* outside of cultivation.

Despite being undoubtedly the most widely known and grown of all carnivorous plants, the Venus flytrap has a surprisingly small natural distribution, straddling the border between North and South Carolina in the United States, where it inhabits low-lying acidic peat bogs and open pine forests. It is usually found in open, sunny sites where the plants can develop a vivid colouration. In shaded areas, the plants are often larger and green, with no red colour, due to a lack of light. Here, plants will produce longer leaves which typically are unable to hold themselves upright when mature. This is the plant's attempt to reach brighter sunlight.

Its range is Zone 9, with snow being of rare occurrence, but with an average winter minimum of 15°F (-9°C), occasionally lower.

The growth pattern of Venus flytrap follows that of most temperate species, commencing in my nursery in March generally, with a flush of new leaves. Typically, plants form a flat rosette of leaves to 4 in. (10 cm) in diameter, often in conjunction with a number of upright leaves in the summer months. Occasionally this latter type of leaf predominates. There is a cessation of leaf production in early summer, with each plant or active growth point producing a single flower stalk. These are easy to recognize as they are circular in cross section. Flowers attain a height of 12 to 16 in. (30 to 40 cm), and are topped with eight to ten blooms approximately 1 in. (2½ cm) in diameter, which open one to three at a time. Flowers are white, with each petal bearing fine green veins along its length. They open for a couple of days before closing, with the scape remaining green until autumn, when the seed is ripe.

Venus flytraps are self-fertile after an initial period, but require manual pollination, a process as easy as rubbing the fine structures of the flowers gently together, or using the fine-haired paintbrush mentioned earlier and going from flower to flower, gently brushing over the pollen-bearing stamens and then transferring the pollen to the central stigma (receptive when it has feathered out). Pollen is released initially prior to the



stigma becoming receptive, to encourage cross- rather than self-pollination. Seed heads gradually swell and split in the autumn, to display around thirty shiny black seeds about $\frac{1}{25}$ in. (1 mm) in length.

The leaves are remarkable feats of natural design, and after all these years of growing them, I am still fascinated by the elaborate and sinister-looking traps. They arise from an odd bulb-like structure, which unlike a traditional bulb forms a chain of old-leaf bases, more akin in habit to a rhizome, and indeed it has the ability to branch and divide. Over many years, and in optimum conditions, the plants can form substantial clumps of individuals, all genetically identical.

The leaves are composed of two parts. The lower stem (petiole) in adult plants is usually 1 to 4 in. (2½ to 10 cm) in length, the rosette leaves being shorter than the upright individuals. They are normally a lime-green colour, and also vary in shape and width, with shorter and wider petioles produced in the spring and autumn, and longer thinner ones in the summer, which often hold the traps upright or semi-upright. In autumn, plants will lose a number of their leaves, and these can be simply removed by supporting the base of the plant and gently pulling them away.

The upper section is the trap itself. This includes two lobes held together at their bases at about ninety degrees when open. The upper margins of the lobes are lined with

Shiny black seeds are produced in late summer, seen here in the mature seed pod.

LEFT Flowers will slow the progress of *Dionaea muscipula*, though they are unlikely to kill the plant unless it is weak or dying anyway. If you don't wish to produce seed, pinch blooms out as they appear.

ferocious-looking spines approximately $\frac{1}{2}$ in. (1 cm) in length. They have a flexible quality, rather than being akin to thorns. The interior of the trap varies in colour due to genetics and environment; typically it is a deep red in strong sunlight, in contrast to the green petioles, the trap exterior, and spines. In some forms, the colouration is faint or absent altogether, while in others the entire plant can be a deep red.

The trap's interior surface faces upward, to attract as many insects (both crawling and flying) as possible. It is baited and has to draw its prey in using a variety of methods. Like a

flower, the trap possesses UV patterning, which although not visible to our eyes, is attractive to insects. The sometimes vivid red colouration of the trap interior may also be attractive, although insects see differently than we do.

There are numerous nectar-secreting glands on the interior, especially concentrated in a band under the base of the spines, positioned perfectly for the insect to trigger the trap. Close inspection typically reveals three short, rigid spines $\frac{1}{25}$ to $\frac{1}{8}$ in. (1 to 3 mm) in length, arranged to form a triangle on each lobe. These are the trigger hairs, which taper to a point and possess a hinged base.



Petioles of *Dionaea muscipula*. A shorter spring example on the left; a longer summer leaf on the right.

Once the insect is in the trap interior, it invariably touches one

of these triggers. The first stimulus seemingly does nothing: it is considered to be a safeguard against wind-borne or other debris closing the trap unnecessarily. A second touch is required—on either a different hair or the same one—for the trap to close. Bear in mind: because it can recognize two stimuli, *Dionaea muscipula* is the only member of the plant kingdom that can count.

Traps can close with lightning speed—in as little as *one-tenth of a second* in the case of a healthy plant on a warm day. The mechanism by which this movement occurs is remarkable: charged particles pass through cellular membranes, which in turn cause a number of cells on the outer surface of the trap to expand, pushing the sides of the trap together. There is no hinge mechanism at the base of the lobes.

When the trap closes initially, the spines mesh, leaving a row of gaps allowing the escape of insect prey too small to be of value to the plant. In these cases the trap will reopen within about twenty-four hours. If the insect cannot escape, it will continue to



LEFT Trigger hairs are located on the inside of the trap, typically three on each side.

CENTRE With the second stimulation, the trap snaps shut, spines interlocked.

RIGHT When digesting, the trap seals tightly and the spines reflex outward.

touch triggers as it struggles. The trap closes ever tighter, eventually producing an airtight seal, with the spines bowing slightly outward.

Glands on the leaf's inner surface secrete digestive enzymes onto the insect. The creature's soft parts are broken down; the soluble products are absorbed by the same glands. The duration of the digestion process is dictated by the size of the prey; a small fly may take only two or three days, but a larger item such as a wasp may require ten to fourteen days.

When digestion is complete, the trap slowly reopens, a reverse action to closure, with the inner surface increasing in size and pushing the two lobes apart. What remains inside looks for all intents and purposes to be a complete insect—but closer inspection reveals just the hard, indigestible chitin exoskeleton. In the wild, these wash or blow out, but in the confines of a greenhouse they usually remain on the leaf. A warning perhaps to others!

The closure and subsequent reopening of the trap is an irreversible growth process which can occur several times, and the action of digestion can take place approximately three times per leaf. If the animal caught is too large for the trap, however, the trap will usually blacken and die midway through the process.

CULTIVATION

Considering that the natural range of this plant rarely encounters snow, it's surprising how cold tolerant Venus flytraps are. I have had frozen plants in the nursery to as low as 14°F (-10°C), and I have based my Zone 9 recommendation on this. Bear in mind that



As autumn approaches, the leaves, especially any upright examples, will quickly blacken.

RIGHT A group of individual plants can be potted in a bowl.



this was in the confines of a greenhouse, which afforded some protection. However, I did have a few plants living outside for a number of years, and I know growers whose plants are all outside.

For the healthiest and most colourful flytraps, place them in full sun. They are at their best in a greenhouse or conservatory, or on a sunny windowsill. In those environs, they will need to sit in a tray of rainwater to a depth of 1 to 2 in. (2½ to 5 cm) in the summer. Keep them just damp in the winter months, when they lose any upright traps and retain a few prostrate leaves. The plants should follow the temperate regimen of hot summers and cold winters. Those denied winter dormancy will decline after a few years, so be sure to provide cold surroundings between October and February. Remember, this means moving them out of the house—it may seem chilly to you in the bathroom, but it will still be too warm for *Dionaea muscipula*.

Pot plants in either straight peat moss or a mix of equal parts peat moss and lime-free horticultural sand. A fairly small container, around 4 in. (10 cm) in diameter, is ideal. Fill the pot with your chosen medium, firmly pat it down, and make a hole of finger depth. Thread the fine black roots down into the hole. The white-coloured leaf bases which make up the rhizome structure should be buried in the soil to a depth of about ½ in. (1 cm).



For a more impressive display, consider grouping a number of plants in a larger container, either a pot or a bulb bowl, where the plants will have room to spread. Alternatively, they can sit and happily snap away at the front of a planting of other temperate carnivorous plants. I am often asked how to repot these plants without triggering the traps, and the answer is quite simply that you can't. A newly repotted plant will look dreadful, but don't worry, the new pot will encourage new growth, and before long, the plants will once again look happy and healthy.

Much has been said of the flowering process killing plants, and although there is an element of truth to the claim, it is certainly not always the case. To be expected to successfully flower and reproduce, a plant should be mature and in good health, and its

CLOCKWISE FROM
TOP LEFT:

A large, mature
plant in need of
dividing.

Dionaea muscipula
divisions, ready for
potting.

Samples of leaf
cuttings or pull-
ings. Note they are
stripped down to
their white or pink
bases.

A division showing
a section of the
rhizome removed.
This can be potted
separately.

winter rest period should be respected. When the flower stalks are produced in early summer, you have the choice of leaving them if you wish to produce seed, or pinching them off if you do not. You will notice a visible slowing in the plant's growth progress while flowering takes place. Don't worry, though—normal growth rate is usually restored afterward

If a plant has not been allowed winter dormancy, or is in general poor health, the flowering process can indeed result in its death. It has also been proposed that a dying plant flowers in an attempt to produce seed and continue its lineage prior to its demise.

PROPAGATION

There are three simple methods of propagating the Venus flytrap, and one made possible in occasional circumstances. The one which will give instant results is division. As a plant grows and branches, you will notice small clumps developing. In the confines of a pot, vigour will begin to slow after three to four years. This is the time to repot and divide the plants. Only attempt this in the spring so the plants have the whole season ahead of themselves to re-establish. Remove the plants from their container and shake off the old potting mix. Mature plants will typically have two or three individual growth points, and usually a chain of old leaf bases which remain alive for a considerable time after the leaves themselves have died.

Begin by removing the chain of leaf bases, retaining them. Gently grasp the growth points and snap them apart. They are quite brittle and will come apart easily, leaving you with individual plants. Pot plants as described.

You will be left with the rhizome. This can itself be useful—at the base of each segment, there is a dormant bud which will begin to grow if exposed. Many plants employ this tactic as a safeguard if the main stem or crown of the plant is damaged. By breaking the rhizome into pieces $\frac{1}{2}$ in. (1 cm) in length, you can use the pieces as cuttings. Simply reduce the length of the roots by half, and push them into a container or seed tray to half their depth. Green shoots should appear in around four weeks.

Leaf cuttings are just as straightforward, though the word “pulling” is more appropriate. One aspect is essential for success: the leaf must be complete, including the white (sometimes pink) base. This is where the active cells for regeneration are to be found



A batch of *Dionaea muscipula* seedlings.

(exactly the same as the rhizome cuttings). Select a healthy plant with six to eight leaves and remove it from its pot (you could try to pull the leaves out without doing this, but you'll snap at least half of them).

Holding the plant, carefully strip up to half of the leaves downward so that the whole leaf comes away. Select as many as you require and snip off the traps. Fill a seed tray with peat moss and soak well, before laying the leaves on the surface so that the bases are all pressed in $\frac{1}{8}$ in. (5 mm). A light sprinkling of sphagnum moss will help keep the humidity high around the developing plantlets. You can either stand the tray in water somewhere shaded, or cover with a plastic bag and place on a bright windowsill out of direct sun.

Small plants will be visible in three to six weeks. Once they are 1 in. (2½ cm) in height they can be treated as adult plants. Pot them separately the following spring. Be careful to harden plants off first by making a small hole in the bag every day for a week before transplanting, so they do not dry out. Also keep in mind that they will scorch if placed in full sun immediately, so introduce this gradually as well.



Dionaea muscipula
'Australian Red
Rosette'.

RIGHT *Dionaea
muscipula* 'Cross
Teeth'.



Propagating by seed is straightforward, if somewhat slow. Once the flowers have produced their seed in the autumn, stratify and sow them as described in the cultivation chapter. From seed to maturity is three to five years, but you will have the benefit of raising plants of various stature and colour.

Finally, there is a strange phenomenon in which plantlets are sometimes formed on the flower scapes, in addition to the flowers, attaining a good size over the course of the season. Plantlets can be carefully snapped off and will generally root through in a few weeks. Although this is another intriguing aspect of these plants, it is a fairly rare occurrence, and cannot be regarded as a reliable method of propagation.

Plant Suggestions

Dionaea muscipula is a variable plant; though it has not been formally broken down into any recognized varieties, there are a large number of formally and informally named cultivars and variants, a few of which I shall describe.

First though, a note on naming. As described in the introduction, plants are given the status of cultivar for an outstanding or unusual characteristic that makes them horticulturally desirable.



In recent years there has been a large number of Venus flytraps afforded this accolade for being hideously deformed—usually the case of a fault in the tissue culture process, causing occasionally stable mutations. One has only to read the cultivar descriptions to see the oft-repeated line that the plant was “discovered in a garden centre” to realize that these random mutations are being exploited by individuals who seek to make a name for themselves. In reality, such abominations deserve no future other than the compost heap.

Don’t get me wrong. There are a few deformed cultivars which are attractive, but the current craze for naming the most abhorrent of tissue culture’s mishaps really should stop. Back in the 1980s there were no cultivars to speak of, merely a range of forms

CLOCKWISE FROM
TOP LEFT:

Dionaea muscipula
‘Dentate Traps’.

Dionaea muscipula
‘Red Piranha’.

Dionaea muscipula
‘Sawtooth’.

Dionaea muscipula
‘Royal Red’.

designated by colour, generally combinations of red and green. The discovery of the first all-red forms in the early 1990s began the surge of cultivar naming we see today. With that in mind, here are a few worthy cultivars.

‘Australian Red Rosette’, a large and squat plant, produces flat, prostrate rosettes. Its large, chunky traps grow to 1½ in. (3 cm) across, always held flat to the ground. Vivid crimson colouration contrasts with apple-green foliage.



Dionaea muscipula
‘South West
Giant’.

An unusual plant of small stature, ‘Cross Teeth’ produces traps with long, eyelash-like spines, some of which are slightly fused, causing them to cross over. The interior of the traps is a bright blood-red colour.

‘Dentate Traps’ is similar in size to ‘Royal Red’, but with normal green and red colouration. Its teeth are reduced from spines in the spring to jagged, triangular points in the summer. A large number of different plants are now circulating with this characteristic—this was foreseen and a Dentate Traps Group has also been registered.

‘Red Piranha’, an all-red plant, produces traps with teeth that are reduced in the same way as ‘Sawtooth’. Flat rosettes produce traps to ¾ in. (2 cm).

The first of several very similar plants to have been named, ‘Royal Red’ produces leaves and a flower scape that develop a uniform purple-red colouration. Summer leaves are around 5 in. (12 cm) in height and are held erect, with traps to about 1 in. (2½ cm). Flowers are the same as the type.

‘Sawtooth’ is an interesting variety in which the teeth, similar to ‘Dentate Traps’, are reduced. Here, they form a margin which, as the name implies, resembles that of a saw.

‘South West Giant’ was named by my good friends Alistair and Jenny Pearce of South West Carnivorous Plants in Devon. A large and vigorous plant, it bears the typical colouration but grows large summer traps on long petioles to 1½ in. (4 cm) across.

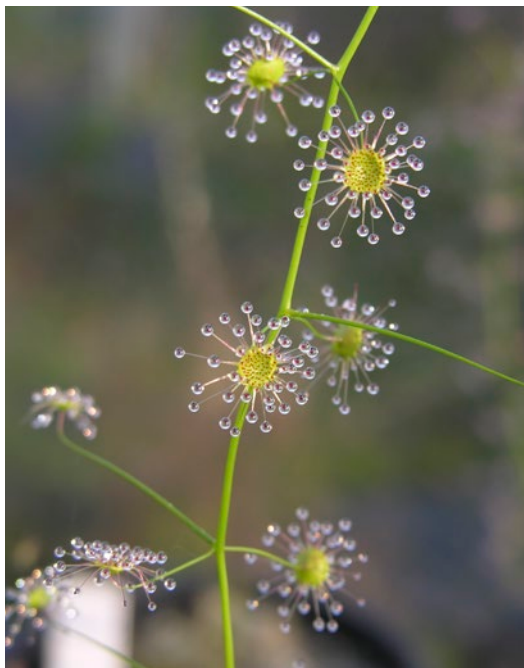


Drosera callistos is a pygmy species.

Drosera

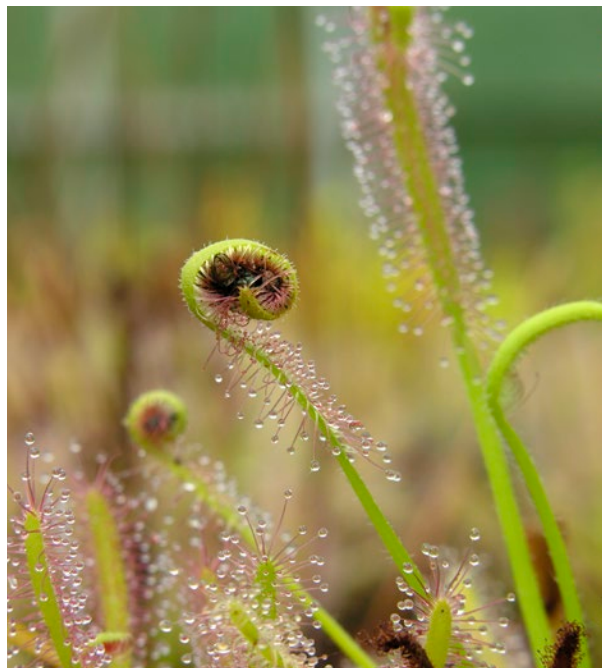
SUNDEW

Drosera is a genus of over 200 species, with worldwide distribution. Plants are found on every continent except Antarctica—a truly successful and remarkable group when one considers the adaptations they display to survive in their respective habitats. Some species make ideal and visually impressive plants for a bright windowsill, where the sun will



An example of a tuberous species, the climbing *Drosera pallida*.

RIGHT *Drosera capensis* wrapping its leaves around a housefly.



illuminate their leaves and give them a fiery appearance. In this location, the five-petaled flowers of droseras are produced at various times during the growth cycle of the plant, and are usually open for one to three days.

The headquarters of the genus is Australia, with some 50 percent of all known species, followed by South Africa and South America. The remaining species are found across Asia, Africa, Europe, and North America, as well as unusual species endemic to islands, including Madagascar and New Caledonia.

With a small handful of exceptions, they are all perennials, varying greatly in shape and stature from the tiny *Drosera occidentalis* from Australia, barely $\frac{1}{3}$ in. (8 mm) in diameter, to the stately and regal *Drosera regia* from South Africa, which can produce a leaf 18 in. (45 cm) in length. The plants display an uncommon variety and diversity, and although many are beyond the scope of this book, it is worth mentioning these adaptations, in the hope that you will become addicted to these beautiful plants.

The temperate species lose their leaves in the autumn, and instead produce a tight winter resting bud, often termed a hibernaculum, to protect the base of the plant against winter cold. Our native European and North American species adopt this strategy, with one species, *Drosera filiformis*, clothing itself in a mass of fuzzy brown hair. The plants sit in this suspended state until the return of warmer conditions in the spring, at which time the bud opens up and new leaves emerge. A similar challenge is presented to those species whose habitats become too hot or dry for part of the year. That hotbed of species, Australia, includes a couple groups of sundews that have this challenge to overcome.

The tuberous species, of which there are around fifty, are predominantly found in Western Australia, and grow in the cooler and wetter winter months, a habit that they continue in cultivation. Some species produce their growth and develop, flower, and set seed in only three to four months, before they die back in the spring and retreat underground, away from the heat of summer, resting in a tuber until the following autumn. The tuber is a storage organ, the most common example being a potato.

The same region of Australia is also home to most of the thirty or so species of pygmy *Drosera*, which as the name implies are all small in stature, but must still employ a tactic to survive the harsh heat of summer. They utilize a couple of methods to do this. Firstly, they produce a structure similar to the hibernacula of temperate species, and lose their leaves. However, they cover this with white- or silver-coloured hairs called stipules—small outgrowths that can be found on most species of *Drosera*. Instead of the hairs serving as protection from cold, as with *Drosera filiformis*, these are enlarged and serve to reflect the heat of the sun away from the growth point.

A few species appear to take it one step further, and produce a stem. In *Drosera dichrosepala*, this can be up to 4 in. (10 cm) in height. As they become taller, they produce



The dormant resting bud and stipules of *Drosera closterostigma*.

TOP A dormant winter resting bud of *Drosera filiformis*.

aerial roots which serve to steady the plant, resulting in what appears to be a plant on stilts, held up above the baking soil surface. For some South African species, the habitat, as in Australia, dries over the summer. To survive this, a number of species produce



Drosera capensis,
wild in South
Africa.

roots which are thick and fleshy, and in a way similar to tuberous plants, they lose their growth in the spring and the roots remain dormant until the following autumn.

Whatever their particular environmental adaptations, all droseras share a common characteristic: leaves with mobile tentacles, each of which is furnished at its tip with a swollen gland surrounded by a droplet of mucilaginous glue. The density of these tentacles varies between species, with some densely embellished and others, such as the Australian *Drosera schizandra*, having only a sparse covering.

Structurally they are all similar, and the amount of movement varies; some barely moving at all. The length of the hairs is loosely dictated by the size of the leaves. In a number of species, the leaves themselves are also capable of movement, curling over and around their prey like an octopus, wrapping up flies and even wasps. In *Drosera capensis* and *D. regia*, the effect can be dramatic.

Prey are attracted to the glistening leaves by the promise of nectar, with the mucilage reflecting light both in the visible and ultraviolet spectrums, an enticing lure to insects. However, on contact with the leaf, an insect soon become ensnared in the glue, which because of its elastic properties, effectively smothers the animal as it struggles. This movement is detected by the leaf and the surrounding tentacles, which bend inward toward the animal, ensuring as many hairs as possible make contact. In the case of species in which the leaf itself moves, this can be a substantial number. The movement is slow and barely visible to the naked eye, although some



LEFT A typical *Drosera* flower on *D. rubrifolia*.

RIGHT Seed from *Drosera* plants is tiny. Shown here is *D. capensis*.

species are furnished with a row of extra-long tentacles on the leaf tip, which are able to snap over very quickly. The insect soon suffocates, as the glue blocks its breathing pores. Enzymes are then released through the tentacles, entering the insect's body. During the digestive process, the resultant soluble nutrients are absorbed into the plant before the leaf and tentacles gently unfurl, leaving only the insect's exoskeleton.

CULTIVATION

These few basics apply to the entire genus; specific individual requirements are covered in Plant Suggestions.

Whatever their origins, nearly all species of *Drosera* require full sun. For such seemingly delicate plants, they are remarkably tolerant, reveling in the greenhouse, conservatory, or sunny windowsill, where most houseplants would burn.

The commonly grown species are generally bog plants, and they need to permanently stand in a tray of rainwater. This can be to a depth of 2 in. (5 cm) or deeper during the hot summer months and reduced in the winter to a thin film. But plants can never dry out, as this will certainly kill them.

The majority of temperate species need a hot summer and a cooler winter period. The depth of cooling is dictated by the plant's origin, with the cold tolerant species being best in an unheated greenhouse or outdoors. But many species are content in a position where there is a lesser drop in temperature, making them ideal for cool windowsills.

For virtually all the *droseras* covered here, a potting mix of equal parts peat moss and lime-free horticultural sand is generally perfect; I'll mention any variance from this with individual listings. Those plants which require similar conditions can be planted together in a single container or bowl—creating a sticky alien landscape.

PROPAGATION

The majority of *droseras* grow easily from seed, surface sown onto the same potting mix as the adult plants. Seed should be collected late summer, stored in the fridge, and sown in the spring. The cold tolerant species require a cold stratification as described in the

cultivation chapter. Most species appear to be self-fertile, though not all these self-pollinate, and may require manual intervention if you have only a single plant. Flowers are usually pink or white, and in a very few cases are fragrant. Seed is tiny, usually around 1/25 in. (1 mm) in length and very narrow, and is often produced in large quantity. To collect seeds, simply cut off the spent flower scape while ensuring it remains upright. Turn it upside down over a sheet of paper, onto which the dust-like seeds can fall. A gentle tap will shake any stragglers free. Seed germinates in two to four weeks. Depending on the species, adult plants can be produced in as little as one to two years.



A planted bowl of mixed sundews makes an interesting and unusual display. Two forms of *Drosera capensis* are at the rear, *D. cuneifolia* is front left, and *D. slackii* is front right.

A number of species produce long roots, and can be propagated by root cuttings. This simple procedure, best performed in the spring, involves unpotting the plants, shaking off the potting mix, and breaking off around half the length of the roots. These root cuttings are then placed on the surface of the same planting mix from which the adult plant came. A seed tray works well for this. Cover seeds lightly with potting mix. New plants will be seen in four to six weeks. The donor plants can be repotted.

There are a very small number of *Drosera* hybrids, mostly man-made. These are all sterile, so seed cannot be produced from them.

Plant Suggestions

Drosera adelae

Drosera adelae is one of three species found in the Queensland rainforest, the others being *Drosera prolifera* and *D. schizandra*. They are known collectively as the Queensland sundews. *Drosera adelae* is a perennial evergreen hailing from a tropical region, making it an ideal candidate for terrariums, where it will thrive in the warm environment. The plant produces lance-shaped leaves to 3 in. (7½ cm) in length, which unfurl in a semi-erect fashion and gradually lower to a prostrate position. The upper surface is covered with sticky tentacles. Leaves are a bright green in low light levels (something this species is able to tolerate), and flush an attractive bronze-red colour in good light. Short flower scapes to about 3 in. (7½ cm) high are produced in the summer months, each with a dozen or so small, red-petalled, star-shaped flowers to ⅓ in. (8 mm) in diameter.

CULTIVATION This plant can be grown in a greenhouse or conservatory, a terrarium, or on a windowsill with indirect light. It will tolerate lower light levels and is one of the very few species that can grow on a shady windowsill. As it requires good humidity, it is best to keep it in the confines of a propagator with its sister species. It also grows well in the type of low bowl you see for hyacinths and similar bulbs. Maintain a winter minimum of 45°F (7°C).

PROPAGATION This species doesn't self-seed, but is one of the few species of sundew which produces daughter rosettes from its roots, forming clumps and filling its container over time. These offspring can be simply dug out and potted separately, preferably in the spring.

Drosera aliciae

Drosera aliciae is one of a number of evergreen, rosetted species found in South Africa. Many look very similar at first glance, and many are also variable, which has led to



Drosera adelae.

TOP The unusual star-shaped flowers of *Drosera adelae*.



Drosera aliciae.

much confusion concerning their identity over the years. This plant produces rosettes of 1 to 3 in. ($2\frac{1}{2}$ to $7\frac{1}{2}$ cm) in diameter composed of pale green leaves. The leaves are wedge-shaped and slightly rounded at their tips, covered on their upper surface by sticky tentacles, which are a beautiful pink-red. In full sun, the leaves can also flush red. During the summer months, tall, wiry flower scapes to 16 in. (40 cm) are produced, unfurling like watch springs from the rosette and covered, as close examination will reveal, by tiny, sticky glands. Around twenty pale pink flowers to about $\frac{1}{3}$ in. (8 mm) in diameter are produced in succession, the lowest opening first.



CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun. Maintain a winter minimum above 32°F (0°C), though no cold period is required.

PROPAGATION This species freely self-seeds, without the need for manual pollination. Store seed in the refrigerator, although a cold stratification is unnecessary, and surface sow in spring.

Drosera binata

The species name *binata* means “divided in pairs” (a reference to the leaves being forked), hence the common name of forked-leaf sundew for the impressive *Drosera binata*. An Australian species, it is found in the more temperate southeast of the country, and also in Tasmania and New Zealand, as well as some other smaller islands. It is a variable species with four distinct forms, all worthy of cultivation for their notable stature and easy-to-please attitude. A well-grown clump of this perennial species is a dramatic sight, especially early in the morning when the sun is low and the plant is ignited in the light.

All *Drosera binata* produce white (occasionally pink-blushed) flowers in the summer months, ½ to ¾ in. (1 to 1½ cm) in diameter, held aloft on sometimes tall, sturdy stems. Most plants in general cultivation appear to be self-sterile, but beware, some forms do self-seed prolifically, scattering their seeds far and wide in the greenhouse. In the autumn they die back to their roots, the entire plant blackening off in a surprisingly short time before the onset of winter. In the spring, they unfurl from the soil, exploding like fireworks.

CULTIVATION *Drosera binata* can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun. The habit of the larger forms makes them best in hanging containers, where they are free to explore their surroundings without interfering with any neighbours. *D. binata* tolerates a winter minimum of 14°C (-10°F).

PROPAGATION The quickest method of propagation is to split mature *Drosera binata* plants that have formed clumps. As they develop in early spring, you can simply pull sections apart, or cut them with a knife. They produce very long, wiry roots, which can also be used as cuttings. Simply spread them on the surface of a pot or seed tray, and lightly cover with planting mix. Within a few weeks you will see leaves developing, and mature plants can be produced in a single year this way. Seed can be stored in the refrigerator

CLOCKWISE FROM
TOP LEFT:

Drosera binata
flowers.

To propagate,
spread divided
roots on the sur-
face of the potting
mix and cover
lightly.

A year after root
propagation, a
sizable clump will
be produced.



Drosera binata var.
dichotoma.

and surface sown in the spring, though that is perhaps a little unnecessary in the case of this species because of the ease with which it can be divided.

Drosera binata var. *binata* is the typical form (commonly referred to as the T-form), an erect plant producing a dense colony of glabrous, green- to bronze-coloured petioles to 6 in. (15 cm), topped by a singly divided sticky leaf, each side 1 to 3 in. (2½ to 7½ cm) in length. The whole plant can attain a height of some 10 in. (25 cm).

Drosera binata var. *dichotoma* is a generally larger plant in all respects. Its leaves are divided twice, similar to *D. binata* var. *binata*, but with an extra pair of points, making four. The petioles can be up to 10 in. (25 cm) in height, and are apple green, blushing red. The

sticky leaves can be up to 5 in. (12½ cm) in diameter. This variety is a little slower to divide than *D. binata* var. *binata*.

Drosera binata var. *multifida* is a finer, more gracile (slender) plant all around. Like *D. binata* var. *binata*, it forms a dense clump, but we see a change of habit in this



Leaf examples.
From left: two leaves of *Drosera binata* var. *binata*, one leaf of *D. binata* var. *dichotoma*, one leaf of *D. binata* var. *multifida*, and one leaf of *D. binata* var. *multifida* f. *extrema*.

variety—from upright to hanging over the edge of the container, due to leaf weight. And the leaves in this plant are divided still further, typically to eight to ten points; the forms in cultivation bear leaves to around 4 in. (10 cm) in diameter, held on thin petioles to a similar length.

Drosera binata var. *multifida* f. *extrema* represents this species at its most extreme (pardon the pun), and in my opinion, at its most beautiful. Frequently boasting leaves of over twenty points, (in the wild, the figure of sixty has been

suggested), these sticky red spider webs can attain a diameter of 8 in. (20 cm) on hanging, similarly coloured, wiry petioles to 10 in. (25 cm) in length. In the wild they are often found on vertical cliffs, where their hanging habit works perfectly, projecting traps out into the air, where they lie in wait for prey. It will survive 14°F (-10°C), but does seem to regrow slower in the spring. Try to keep this form above freezing.

Drosera capensis

A native of the Cape region of South Africa, *Drosera capensis* is absolutely the first plant you should have on your windowsill (after the obligatory Venus flytrap, that is). Surprisingly rare in the wild, this showy and impressive plant has everything a beginner could hope for. It produces long, strap-shaped leaves to 4 in. (10 cm) long, which are covered in vivid red tentacles for half their length. Small houseflies and similar insects are fatally attracted, and the plant catches these with relish, leaves curling over and winding up their prey, then unfurling when they have finished their meal. In the summer a profusion of self-fertile pink flowers are produced on tall, slightly hairy stems to over 12 in. (30 cm), followed by many seeds, which can be stored and sown in the spring. The ease with which this species can be grown makes it the perfect plant for children to grow. A few



rather attractive all-red forms are also in cultivation, identical in all respects except for the entire plant developing an intense red colour—a perfect contrast to the standard forms, and also to the green stems of *Sarracenia*, when grown together. When kept above the freezing point it remains evergreen, though it can freeze and will die back to its roots, returning in the spring. This deep freeze isn't a requirement, though, and the plant can be kept indoors year-round.

CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun. Maintain a winter minimum above 32°F (0°C) to preserve evergreen leaves.

PROPAGATION Individual plants will gradually divide and can be split in the spring. Alternatively, sow the copious amounts of seed.

Drosera filiformis

Drosera filiformis is an interesting North American species with self-supporting, thread-like leaves held in unusually attractive upright clumps, up to 8 in. (20 cm) in height. There are two varieties: *Drosera filiformis* var. *filiformis*, which is a finer, more delicate plant, with green leaves and red tentacles; and *D. filiformis* var. *tracyi*, which is a stockier plant with green leaves and white tentacles that catch the low morning sun beautifully. Plants die back to a winter resting bud and need to be kept cold over the winter months, re-emerging in the spring, their leaves unwinding out of the base. Large, pale pink, self-fertile flowers to 1 in. (2½ cm) across are produced in the summer.

CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun in the summer. It must be cold over the winter, so somewhere unheated or outside is best. It is also good in the bog garden or in an outdoor container. As a pond marginal, it will complement *Sarracenia*, with which it grows naturally in the wild. *Drosera filiformis* tolerates a winter minimum of 14°F (-10°C).

PROPAGATION Individual plants will gradually divide and can be split in the spring. Leaf cuttings also work well. Take cuttings in the summer, slice them into 1-in. (2½-cm) lengths, lay them on a surface of potting mix, and lightly cover with a little sphagnum moss. Young plants are formed in four to five weeks. Alternatively, sow seeds in the spring after they have been stored in the refrigerator. Being temperate, cold stratification is necessary prior to germination.

CLOCKWISE FROM
TOP:

The easy and
vigorous *Drosera*
capensis. Make this
your first drosera.

Drosera filiformis
var. *tracyi* enjoying
the morning sun in
a greenhouse.

A beautiful red
form of *Drosera*
capensis.



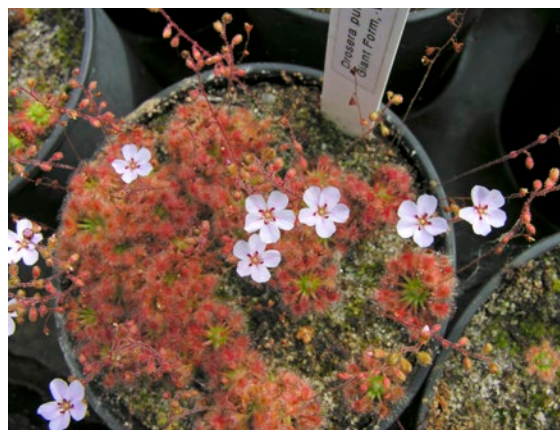
The olive green rosettes of *Drosera hamiltonii*.

Drosera hamiltonii

One of my favourite species, *Drosera hamiltonii* from Australia is another rosetted plant which reaches about 2½ in. (5 cm) across. It is unusual in its colouration—rather than the standard pale green of its fellow species, it is a dark olive green, offset with purple tentacles, quite unlike any other. For the larger part of the year it is a spectacular plant, with its bejeweled leaves shimmering in the sun. But in the hottest part of the summer, it can lapse into a state of semi-dormancy, where the leaves are temporarily stripped of their glue. It is one of those plants best described as shy to flower, and indeed over the past twenty-five years I've succeeded only a handful of times, often a short period after repotting. The deep purple flowers are worth the wait, borne on wiry glandular



Tiny *Drosera pulchella* rosettes.



RIGHT Flowers of *Drosera pulchella*.

stems to 16 in. (40 cm) high and over 1 in. (2½ cm) across—huge for a drosera. They are self-sterile.

CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun in the summer. *Drosera hamiltonii* prefers a winter minimum of 41°F (5°C), no cold period required.

PROPAGATION Individual plants will gradually divide and can be split in the spring. They also produce very long roots which are ideal for cuttings. Lay them on the soil surface and cover lightly. New plantlets will appear in a few weeks.

Drosera pulchella

Drosera pulchella is one of the Australian pygmy species I mentioned earlier. Although not large and showy, the plant is fascinating, whether used as stand-alone specimen or mixed with other species. Plants are around ¾ in. (2 cm) in diameter, and a bright vivid green colour which would certainly highlight others. In addition to this, they also produce correspondingly small flowers to ⅕ in. (5 mm), usually pale pink, but white and orange in some forms. Seed is rarely produced.

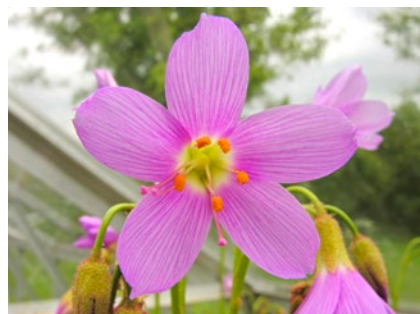
CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun in the summer. *Drosera pulchella* prefers a winter minimum of 41°F (5°C); no cold period required.

PROPAGATION Pygmy sundews employ a somewhat different tactic for propagation. In the latter half of the winter months, a number of tiny green buds, gemmae, are produced in the centre of the plant. These vegetative buds can be transferred, using a fine paintbrush, from the plant onto a sheet of paper, or directly onto the surface of new quarters. They will grow into clones of the adult plant. This is best performed every two to three years for all the pygmy species, as the plants are fairly short-lived and lose their vigour.

Drosera regia

Meet the king of the sundews. I'm including the remarkable *Drosera regia* not because I would necessarily recommend it as a plant for beginners, but because any book that covers this genus would be doing a great injustice to not include it. It is found in just a single valley in South Africa, where it is divided between two tiny populations, and holds the honor of being the largest member of the genus in terms of bulk. The beautiful, sword-shaped leaves rise vertically, slicing through the air to a height of 15 in. (37 cm). They are wider at their bases, to 1 in. (2½ cm), taper along their length to a point, and are covered on the upper surface with large, sticky tentacles. The underside is smooth with a prominent, raised mid-rib. This is the only drosera to produce a rhizome, gradually dividing over a number of years to become a substantial sticky monster.

Its size makes it capable of taking on larger prey such as wasps, and its leaf movements are agile, ensuring nothing escapes. Through the summer months, mature plants produce tall flower scapes to 24 in. (60 cm), which support a cluster of around twelve large flowers to 1 in. (2½ cm) across. Different in structure than the blooms of other species, these flowers are bright pink with darker veins and glowing yellow stamens. Over the winter months the plant dies down, losing its carnivorous leaves and producing a few non-glandular leaves which are often only about 1 in. (2½ cm) in length. Growth is resumed in the spring. This is one of those plants with a reputation for being a bit of a diva, though it seems to do well once established. Perhaps try a few of the more forgiving species first.



Flower of *Drosera regia*.

TOP Stately *Drosera regia* plants in a greenhouse. The large stature means it is best here or in a conservatory.

CULTIVATION This plant can be grown in the greenhouse or conservatory, where it will receive full sun in the summer. Because of its large size I wouldn't recommend it for the windowsill. The king of the sundews prefers a winter minimum of 41°F (5°C); no cold period required.

PROPAGATION Individual plants will gradually divide from their rhizome and can be split in the spring. They also produce very long, thick roots which are ideal for cuttings. Lay them on the soil surface and cover lightly; new plantlets will appear in a few weeks.

Drosera rotundifolia

The common round-leaved sundew *Drosera rotundifolia* is one of three species native to the UK and has a vast distribution throughout Asia, Europe, and North America. Surprisingly, despite this huge range, it is not particularly variable. It produces a loose rosette to 3 in. (7½ cm) in diameter of semi-erect to prostrate leaves, each consisting of a thin



Drosera rotundifolia, in the wilds of southern England.

petiole topped by a round glandular leaf. This, along with its native colleagues *Drosera anglica* and *D. intermedia*, is one of the stalwarts for the bog garden, and is perfect when grown in a carpet of green sphagnum moss, with its red-highlighted leaves held aloft. In the summer, short flower scapes to 4 in. (10 cm) in height are produced, topped with small white self-fertile flowers.

CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun in the summer, but it doesn't appreciate excessively high temperatures. It must be cold over the winter, so somewhere unheated or outside is best. It is also good in the bog garden or in an outdoor container. As a pond marginal, it will complement other carnivorous plants. *Drosera rotundifolia* tolerates a winter minimum of -4°F (-20°C).

PROPAGATION This species is best propagated from the seed that it freely produces. It can be collected and stored in the refrigerator, or left to fall in situ, where the plants will gradually colonize. A cold stratification is essential for germination.



Flowers of *Drosera slackii*, with guest.

LEFT The fragrant rosettes of *Drosera slackii*.

Drosera slackii

As far as the rosetted species are concerned, spectacular *Drosera slackii* is hard to beat. It boasts large, stocky, deep crimson rosettes to 3½ in. (9 cm) across. Over the summer, these rosettes send out wiry, red glandular flower scapes topped with deep pink flowers ½ in. (1 cm) in diameter. The plants gradually form pedestals. A native of South Africa, this is a perfect candidate for anywhere in full sun where its remarkable colouration can develop. An interesting quirk of the plant is the release of a floral fragrance from the rosettes in hot weather; the flowers have no discernible scent. Whether planted in a mixed scheme or used as a stand-alone plant, this species is one you shouldn't be without.

CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun in the summer to produce its best colour. *Drosera slackii* prefers a winter minimum of 41°F (5°C); no cold period required.

PROPAGATION Individual plants will gradually divide and can be split in the spring. They also produce very long roots, which are ideal for cuttings. Lay cuttings on the soil surface and cover lightly. New plantlets will appear in a few weeks.



Drosera spatulata,
easy to grow
year-round on a
sunny windowsill.

Drosera spatulata

Another rosette species with wide distribution, *Drosera spatulata* is found in Eastern Asia, down through Southeast Asia, and across the area known as Australasia. Its wide range affords it broad diversity, and there are many forms. Some of these were named informally in cultivation, but are now diluted by the varied strains which have been introduced over the past thirty years. The plants produce loose rosettes of spoon-shaped leaves, between $\frac{2}{3}$ and 2 in. ($1\frac{1}{2}$ and 5 cm) in diameter, in an array of colour variations from plain green to blushed through with orange, pink, and red. The self-fertile flowers, held on fine scapes, are either white or pink. At barely $\frac{1}{8}$ in. (5 mm), the blooms aren't

particularly impressive, but do add interest. Some forms from colder climates will cease their growth and produce a winter rest bud, resuming in the spring, but they will not survive a deep freeze outside.

CULTIVATION This plant can be grown in the greenhouse or conservatory, or on a windowsill where it will receive full sun in the summer to produce its best colour forms. *Drosera spatulata* prefers a winter minimum of 41°F (5°C); no cold period required.

PROPAGATION The easiest method of propagation is by seed, which this species produces well. Surface sow these in the spring, and adult plants can be raised in a little over a year.

Pinguicula

BUTTERWORT

There are somewhere in the region of eighty species of butterwort, found across Asia, Europe, and North America, along with a small handful of satellite species in countries such as Cuba and Japan. However, the main concentration is in Central America, specifically Mexico, which over the past twenty-five years has yielded a large number of new species. These plants impart a subtle beauty and elegance which makes them enchanting specimen subjects in the home. At first glance, most people would not suspect these beautiful and at times innocuous plants of any untoward habit such as carnivory. They typically produce a flat rosette of bright green leaves pressed to the ground, from which they launch the most delicately beautiful flowers, always borne singly.

The leaves, upon close inspection, reveal thousands of tiny, sticky hairs, which when touched impart a greasy feeling—hence the Latin name deriving from *pinguis*, which refers to fat, and *ula*, being small. Tiny insects generally smaller than a housefly become ensnared in this mucilage and suffocate. Glands on the leaf surface release digestive enzymes onto the carcass, breaking it down. Some species have the ability to move, though slowly; motion is usually restricted to the curling over of the leaf margins to prevent the loss of prey and valuable digestive juices.

The flowers of all species are beautiful, with some being barely ½ in. (1 cm) across and others up to 2 in. (5 cm). The flowers are symmetrical in only one plane, and can

be divided in half from top to bottom—a characteristic shared with the bladderworts (which belong to the same family). Blooms consist of an upper and lower lobe; the upper is divided into two sections and the lower is divided into three. Many of the flowers last



Flower of *Pinguicula* 'Tina'.

for over two weeks, and can bring a welcome splash of colour at an otherwise drab time of year. This colour, when combined with props such as tufa (on which some species naturally grow), can be used to great effect when creating a small display.

CULTIVATION

Just as they are found in diverse environments, butterworts have different requirements in cultivation. For our purposes, the two most common groups of species are the Mexican and the temperate.

MEXICAN SPECIES While a few of the Mexican species are evergreen and grow in an environment that favors year-round growth, the majority do not, losing their carnivorous leaves over the winter in favour of a reduced rosette of many small, non-carnivorous succulent leaves. A number of species flower while in this state. The reason for the change of growth habit is not to protect the plant from cold; rather it is an adaptation against desiccation where winters are cool and dry.

Mexican species of *Pinguicula* are somewhat different in their requirements from temperate species, and can be regarded as more akin to houseplants, a role in which they can excel. A key distinction, though: their potting mix requirement is a far cry from that needed by temperate species. Do not be tempted to keep them in wet peat moss or similar, as they are prone to rotting—though a few commercial hybrids are able to tolerate this, especially those that grow year-round. There are a couple of options for planting material. For many years I had great success with a mix that was equal parts perlite, vermiculite, and sand, with a small scattering of peat moss to provide an element of organic matter. In recent times, I've found that the plants seem to be happy in coarse Cornish grit (crushed granite), with nothing else added. This is one group of plants for



which you could ask a dozen growers about preferred potting mix, and receive a dozen different answers.

Mexican species plants are often found naturally on north-facing cliffs, away from direct sun, so a degree of shading is necessary. This makes Mexican *Pinguicula* species some of the few carnivorous plants that will thrive in indirectly lit windowsills and conservatories that are not suitable for their sun-loving cousins. While this means they are not good candidates for mixed display, their singular beauty makes them stellar stand-alone specimens. As their carnivorous leaves die back in autumn, they are best kept dry until spring, when growth resumes. A daily mist of rainwater is quite sufficient for their needs when they are dormant, and they can remain inside year-round in a cool location. If you are growing Mexican species in a greenhouse or conservatory, they prefer a winter minimum of 45°F (7°C). Although a brief freeze seems to do little harm to the winter rosette, it will result in the destruction of any remaining carnivorous leaves. Plants should stand in rainwater for the growing season, to a depth of around ½ in. (1 cm); the coarse nature of the potting mix ensures that the soil surface will remain somewhat damp rather than wet. The root systems of these plants are surprisingly shallow and the dampness is perfectly sufficient. Once a plant has formed its winter rosette, stop watering and allow it to dry out. This mimics conditions in the wild, where it adapted to endure an arid environment. If, however, your plant remains in growth—as species such as *Pinguicula moranensis* and some horticultural hybrids do—continue to water as usual.

LEFT The winter rosette of *Pinguicula crassifolia* forming in the autumn.

CENTRE *Pinguicula grandiflora* and friends in a bog container.

RIGHT Some hardy *Pinguicula* species in a bowl: *P. grandiflora* subsp. *rosea* in front, *P. poldinii* behind.

TEMPERATE SPECIES Temperate pinguiculas are found across Asia, Europe, and some parts of North America, and behave in the usual manner of bog plants—that is, producing growth during the more conducive summer months, then dying back to a much-reduced winter bud (hibernaculum) in the colder months. These species require a cold winter and are hence unsuitable for indoor cultivation, but are in some cases perfect for outdoor culture tolerating a winter minimum of 14°F (–10°C). Once they produce their hibernacula and the carnivorous leaves die back, cooler temperatures are imperative. As with hardy sundews, temperate pinguiculas are naturally small in stature, and can be used as complement plants in a bog garden. The European species are ideal for this, especially native plants. An alternative is to plant them in containers, which allow closer inspection. This means plants can be moved easily for maximum appreciation when they flower, and such a pot of specimens makes a beautiful centerpiece for a garden table.

Most temperate species of *Pinguicula* prefer a degree of shading. In fact, direct sun can rapidly scorch their delicate leaves, so take care to prevent this. A planting mix of equal parts peat moss and horticultural sand is ideal, or even pure peat moss, keeping them wet in the growing season and, if under cover, damp over the winter. Plants outside will remain wet year-round. Do watch out for birds, which certainly in my locale have a penchant for occasionally picking small plants from pots—no doubt while digging around for suitable food.

PROPAGATION

Seed is a good option with the Mexican species of *Pinguicula*, although plants are not generally self-fertile, so manual pollination is necessary. Seeds are shed toward the end of the dry season. Simply sow them in a tray of the same potting mix as the adult plants and stand in water. A daily spray will help promote germination. Perhaps surprisingly, a number of people have reported good success germinating seeds by floating them on the surface of a dish of water, pricking them out once they have sprouted. The easiest method of propagation for these species can be performed during the winter, when plants are in possession of their tight winter rosettes. Using a pair of tweezers, start at the edge of the rosette and gently pull away the small succulent leaves, taking care to not bruise them. Exercise some caution when handling, but you can be ruthless in the

number you take—it's safe to remove at least a third. Gently push the leaf pullings into the surface of a tray of perlite. Stand in water until they root and produce small plantlets, generally at around four weeks.

For temperate pinguiculas, seed is a straightforward method of propagation. They are often self-fertile, but don't appear to self-pollinate, and outside plants are usually visited by pollinating insects. Manual pollination is a simple process of inserting a small paintbrush into the throat of the flower, then withdrawing while pushing slightly upward before moving on to the next flower. Seed is shed in the autumn and can simply be surface sown immediately and kept cold in an unheated greenhouse or similar. Alternatively, seed may be stored in the refrigerator over the winter and sown come spring. Germination takes around four to six weeks and adult plants develop in two to three years.

Many of the temperate European species also form so-called daughter hibernacula over the winter. Surrounding the main resting bud, a number of much smaller buds often develop. These can be removed with a pair of tweezers—carefully so as not to damage them—and placed on the surface of the potting mix away from the mother plant, where they will develop in the spring. Any buds left on the plant will be smothered when the plant resumes its growth.

Finally, you can split the Mexican species which have divided. This can be done in the spring or while the plant is dormant. It is simply a case of removing the plant from its container and gently pulling the individual rosettes apart.



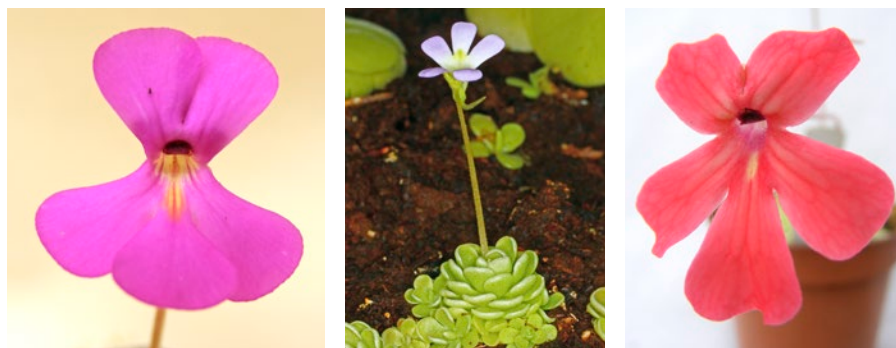
Mexican species that have obviously divided can be split in the spring.

TOP Leaf pullings can be taken from the winter rosettes of the Mexican species.

LEFT Flower of
Pinguicula ehlersae.

CENTRE *Pinguicula*
essariana.

RIGHT *Pinguicula*
lauana.



Plant Suggestions

MEXICAN SPECIES

Pinguicula ehlersae

Pinguicula ehlersae is one of a few closely related and similar-looking species. All are small, and perfect for displaying together in a bowl or similar container, where they flower en masse during the winter. The rosettes are small, to 1½ in. (4 cm) across, and apple green, blushing a delicate pink in good light. The flowers are stunning, an intense purple with an almost iridescent quality, 1 in. (2½ cm) in length.

Pinguicula essariana

Exquisite *Pinguicula essariana* is one of those closely allied to *Pinguicula ehlersae*, sharing many similarities in size and appearance, though the rosettes do not blush pink. Flowers are pale pink with a white throat that is highlighted by a dark purple stigma within. Another great plant to grow as a colony in a small bowl, where the delicate flowers will brighten dull winter days.

Pinguicula lauana

Without doubt, *Pinguicula lauana* is one of the finest species in the genus—and one of only a couple to bear red flowers. The rosettes can be large, to 3 in. (7½ cm) in diameter,



LEFT *Pinguicula moranensis* (white-flowered form).

RIGHT *Pinguicula* 'Tina' in a shallow contemporary tray, ideal for a bright windowsill out of direct sun.

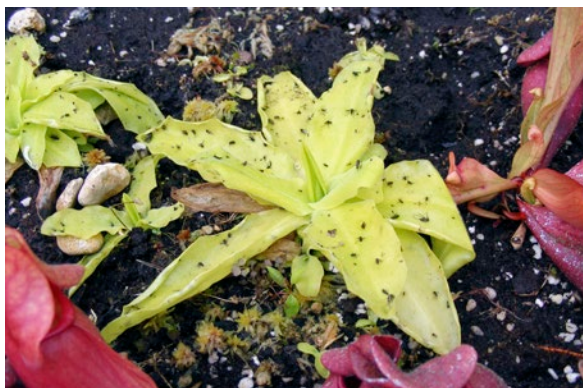
and are bright green, often with a beautiful bronze tint in good light. The long-lasting flowers are spectacular, variable in colour and shape and 1½ in. (3½ cm) long. Some are a deep red-burgundy, others a more pure bright red, but all with some of the finest colouration you will find in this fascinating genus.

Pinguicula moranensis

A variable species, *Pinguicula moranensis* is one of the first Mexican plants to have entered cultivation. Early books split this species into two: *Pinguicula caudata* and *P. mexicana*, but these now-defunct names refer to the same variable plant. It can be large, with huge apple-green rosettes up to 6 in. (15 cm) in diameter, though usually smaller. The flowers are a deep pink colour, with the generally standard white throat. A particularly attractive white-flowered form is also in cultivation and worthy of a place in anyone's home.

Mexican *Pinguicula* hybrids

As with many genera, *Pinguicula* demonstrates hybrid vigour, and in recent years a handful of worthy plants have been named. More important in many respects is that a couple of them have entered the mass production market and are propagated en masse in tissue culture. I say this, as it demonstrates the potential of these particular plants to become houseplants—more so than any other genus of carnivorous plant. Two such plants are *Pinguicula* 'Tina', a grand plant with purple flowers streaked with white and large rosettes



Pinguicula grandiflora.

RIGHT *Pinguicula vulgaris*.



that freely divide to produce a wonderful clump, and *Pinguicula* 'Weser', a smaller plant to 3 in. (7½ cm) in diameter, with stunning purple-pink flowers to 1 in. (2½ cm) across.

TEMPERATE SPECIES

Pinguicula grandiflora

A native species found across Europe, *Pinguicula grandiflora* is one of the showier of the easier-to-grow temperate plants. It forms attractive, slightly lax yellow-green rosettes to around 3 in. (7½ cm) in diameter. In early summer it produces beautiful, blue-purple flowers to ¾ in. (1½ cm) across, each with a white throat which is touched with fine purple veins which contrast well with the darker purple.

Pinguicula vulgaris

Another native plant; known to carpet the wet seeps of mountainous regions in small violet flowers. *Pinguicula vulgaris* blooms are held above the delicate, yellow-green, starfish-like rosettes. The flowers are not as large as *Pinguicula grandiflora*, being slightly closed in comparison, but of a similar colour and with varying degrees of white within the throat. Their vigorous nature makes these plants ideal for the first-timer, and the ease with which they are grown makes them perfect for the outdoor bog garden.

Sarracenia

NORTH AMERICAN PITCHER PLANT

These are the well-known pitcher plants which, certainly in temperate cultivation, are the backbone of any collection. Big, bold, and absolutely essential, these stunning plants give stature and structure when planted into any kind of display. They are also perfect as individual specimen plants, where their singular beauty can be admired. If I had to recommend a single plant to you, it would be one of these.

Found in the southeastern United States, the range of *Sarracenia* extends southward into Florida, west into Texas, and one species, *S. purpurea*, reaches northward into much of Canada.

The genus *Sarracenia* is a member of the family Sarraceniaceae, as are *Darlingtonia* and *Heliamphora*. Found in low-lying boggy areas and coastal plains, the range of *Sarracenia* overlaps with several other carnivorous genera (*Dionaea*, *Drosera*, *Pinguicula*, and *Utricularia*).

Plants growing in open areas and hence subject to the strongest sun can produce the most incredibly coloured pitchers. Those inhabiting more shaded areas, where the surrounding vegetation has encroached habitat, are more dull in colour and will remain that way until a wildfire burns through, removing surrounding scrub and opening the area up again.

There are eight species of *Sarracenia*, six of which have leaves of a similar design: tubular and upright. Leaves of *S. purpurea* and *S. psittacina* are short, open, and squat, and in *S. psittacina*, they produce a flat rosette, pressed to the ground. They are all herbaceous perennials, growing from a stout rhizome which, as with an iris, divides and branches, forming in time a large and impressive individual clump.

The new year begins in most cases with the production of flowers. These never fail to impress those who see them for the first time, as their unusual structure is unlike any other flower.



A dissected *Sarracenia flava* flower. The receptive stigma points are at each of the five tips of the removed umbrella structure on the right flower. They are found just at the base of the notches and protrude inward. Pollen collects on the floor of the umbrella from the stamens you can see at the top of the flower.

OPPOSITE *Sarracenia leucophylla* growing wild in Alabama.



Species are either red or yellow (rarely producing pink or white flowers), but the hybrids, of which there are many, can produce red, pink, yellow, and even orange flowers. They can be large, to over 3 in. (7½ cm) across, and held singly on sturdy stems up to 2½ ft. (75 cm) in height. Each mature growth point is capable of producing a flower, and a large specimen in flower will brighten any dull spring day.

Flowers usually develop before any pitchers are produced (with the exception of *Sarracenia minor* and *S. oreophila*, which leaf first). Once the buds reach their optimum height, they tip over 180 degrees, hanging downward, and open—unfurling and releasing the five petals.

The flowers are self-fertile, but require manual pollination, though the best seed will be produced by crossing flowers of genetically different plants. This is a simple process, as the pollen is released and collected in the umbrella-shaped structure at the base of the flower. This can be collected with the small paintbrush mentioned earlier, then transferred to the five stigma points on the inside of each tip of the same umbrella, or on that of another flower.

Once pollination has occurred, the petals wither and fall, leaving the remainder of the flower. It gradually reverts to its upright position by the time the seeds ripen in the autumn, coinciding with the autumnal die back. Occasionally a plant may produce a flower in the autumn at the end of the season. These are always held low to the base of the plant, seldom on stems more than 3 in. (7½ cm) in height. They die back prior to seed production and can be removed along with the leaves during the annual task of cutting back dead growth.

Cut *Sarracenia* flowers last well in a vase. Even once the petals have been shed, the flower structure remains green for a considerable time. As part of a mixed display with other flowers, or on their own, their unique shape and form make them exceedingly eye-catching. This is also the case with the leaves, and the taller upright specimens make unusual subjects for display, either alone in a mixed vase, or, in the case of elegant species such as *S. leucophylla*, as part of a contemporary piece. Ensure the cut stem is fresh when you insert it in water; if it's been left in the air for more than a couple minutes, recut it just above the initial wound.



The ostentatious bloom of *Sarracenia* 'Joyce Cooper'.

TOP A mature specimen of *Sarracenia flava* var. *ornata*.



Sarracenia flower colours complement each other.

Sarracenia pitchers are produced starting in early spring, the exact time being dictated by geographical location and ambient temperature. Pitchers vary in size and structure, but the upright species can be anything from 6 in. (15 cm) to 39 in. (100 cm) in height. They are typically made up of a leaf rolled to form a tube, with a strengthening ridge along the length of the front, and topped by a lid, which in most cases fully covers the open mouth when viewed from above.

This lid is often brightly coloured and is also covered in glands, which release a nectar with a sweet smell and taste. In some cases, the nectar actually contains the neurotoxin coniine, which paralyzes unsuspecting prey. The lid (which incidentally does not move or snap shut in any way) acts as a convenient landing platform for flying insects, who follow

the trail of the nectar to the underside and throat area, where the alluring substance is most abundant. This area and the rolled lip of the mouth have a waxy feel, with surfaces that insects cannot grip onto. With careful observation, one can observe them slipping, even as they continue to feed.

Eventually, the insects lose their footing and slip into the tube, which narrows rapidly, and is also furnished with many downward-pointing hairs: a one-way system to prevent creatures from crawling out. Once inside, the insects die and are digested by the enzymes released into the pitcher by the plant. The lid is fashioned to channel any water from above down the rear of the pitcher body, away from the mouth, ensuring that the contents are not diluted by excessive rainwater.

In autumn, the leaves die back, and with two of the species habitually producing non-carnivorous winter leaves, the accumulated nutrients of summer hunting are stored in the rhizomes to fuel the following season's growth.

As well as the individual species, there are many hybrids, both man-made and found naturally where the ranges of individual species overlap. *Sarracenias* are unusual in that when crossed, the resultant offspring are approximately midway between the parent plants. The issue of hybridization is further complicated by the fact that the hybrids retain their fertility, so that complex and back crosses can be made, some with spectacular results, others resulting in less desirable plants.

It can be interesting to create one's own hybrids. When breeding from parents of hybrid origin, it is often possible to grow plants of completely different appearances from the same cross, as genetic characteristics from their lineage make an appearance.



Any autumn flowers are held low to the base of the plant and do not produce seed.

CULTIVATION

Despite many *sarracenias* being found in what is regarded as the warm southeastern United States, they are remarkably tough—the more northerly representatives even



LEFT *Sarracenia* flowers are well suited to displays.



CENTRE The leaves can also be cut, some lasting longer than others.



RIGHT A contemporary display using *Sarracenia leucophylla*, *Fatsia*, and *Phormium* leaves.

more so. Temperatures across their range vary, increasing as one moves southward, but many plants still see winter freezes, and all seem to be remarkably tolerant of low temperatures in cultivation.

I recommend Zone 7, with hardiness to 5°F (-15°C). Here in England, I have grown all the species outside, the only exception being *Sarracenia psittacina*, which is best kept under cover—though that said, I have still kept *S. psittacina* below 14°F (-10°C). What's more, they are equally adapted to the other end of the temperature spectrum. This wide tolerance range makes *Sarracenia* pitchers ideal for so many locations: outside in bog gardens or as pond marginals; in greenhouses, conservatories, sun rooms, and sunny windows; anywhere, in short, that receives full sun in the summer.

The key time is winter, when the plants have to be allowed their cold dormancy. If there is any heat in the place where you are keeping them, place them outside or in an unheated greenhouse. The optimum time for this treatment is between Halloween and Valentine's Day. After Valentine's Day, return the plants to their summer quarters if you've moved them. The rise in temperature along with the increasing day length will kick-start them into growth, and you will soon see flower stems appear.

While *Sarracenia* blooms are spectacular, a word of warning. The most frequently encountered and grown species, *S. flava*, produces the largest flowers in the genus,



sulphur yellow and held on tall, erect stems. These are accompanied, however, by a strong and somewhat controversial odour. I must admit that after many years of growing these remarkable plants, my nose smells an acidic lemon perfume, one that reminds me of warm spring days. Others are a little less kind, and the flowers are frequently described as having a feline smell. Judge them for yourself. You may decide to keep them exclusively outside, where they can be admired from afar. The other species are more benign, with faint sweet odours in some, and nothing detectable in others. Once the petals drop, any smell ceases and the plants continue with leaf production.

Watching a tiny shoot develop into a tall tube which then splits and flares open is fascinating, and a true wonder of the natural world. In some species, such as *Sarracenia oreophila*, virtually all the pitchers are produced in the spring, but in others (most notably the exquisite *S. leucophylla*) there are two distinct growth phases: spring leaves which are thin and wiry, and the summer pitchers which are taller, stockier, and usually more colourful.

As the days shorten, the pitchers begin to die back. With *Sarracenia oreophila* this can be as early as late summer, especially if it's exceptionally hot, whereas others such as *S. minor* can retain their leaves well into winter. When they do begin to die back, the first indication is brown patches on the sides of the leaves, where the insects within are

Pitchers offer a kaleidoscope of colour in the summer.

LEFT A fly dances with danger in the throat of *Sarracenia flava* var. *flava*.

CLOCKWISE FROM
TOP LEFT:

Don't panic!
Brown patches
that develop on
the pitcher walls
in summer are
perfectly normal.

Dead leaf bases
from the previous
year can be
removed along
with the current
year's leaf dieback.

By early autumn,
many of the pitch-
ers are dying back.

If you have many
plants, it's often
easier to remove
leaves near their
bases.



broken down. Don't be alarmed at this; it is quite natural and is followed by a browning of the lid which then extends down along the length of the leaf.

At this juncture there is a call to action—the commencement of the most important task of the year. For most of the upright species and hybrids, this means simply waiting until the leaves have died three-quarters along their length from the top downward, then removing the dead section with a pair of sharp pruning shears or scissors. Leave a couple of inches of green base on the plant. Of the upright species, *Sarracenia oreophila* differs in that its leaves die right back to the base. Simply wait until they are completely brown, and pull them away.

If you prefer, you can remove the leaves a little at a time as they brown, though this is not essential and may not be practical if you have a large number of plants. Once the current year's dead sections are removed, you are left with the green leaf bases from those just cut, and a number of dead bases from the previous year's surgery. These dead bases need to be removed, as they are now likely to attract grey mould. Holding the base of the plant, pull the dead bases out. You will notice that a dead base detaches from the



rhizome cleanly, along with the flared joint where it was attached. Not only is this good for preventing disease, it also encourages the rhizome to produce offshoots from a dormant lateral bud, which will often begin to grow once exposed.

Species such as *Sarracenia leucophylla* and *S. rubra* and their subspecies and varieties will lose their spring leaves in the autumn, and their summer leaves will remain green and on the plant well into the winter. Just remove the dying leaves, leaving those still in good condition to enjoy for as long as possible.

Sarracenia flava and *S. oreophila* will produce winter leaves, or phyllodes. These appear at the end of the growth cycle and are non-carnivorous. In *S. flava*, they are sword-shaped and upright; in *S. oreophila* they are sickle-shaped and recumbent, arching over with their tips often touching the soil. These structures can be left on the plant. With *S. flava*, you can cut the leaves down as described, leaving the phyllodes. If they are removed inadvertently, however, there is no detriment to the plant.

Some species retain their leaves until the following spring, and the best time to remove them is at this time as they die back. *Sarracenia minor* can simply be cut back as the new leaves emerge, though this is often while the previous season's leaves are still very much green. *Sarracenia purpurea* and *S. psittacina* are best left until their leaves have died back completely. Then, carefully holding the base of the plant so as to avoid breaking the fragile rhizome, gently pull the leaf away.

The many hybrids will follow one of the patterns above, a characteristic they inherit from one or other of their parents. Just keep an eye on the plant and observe how it behaves in its first season.

LEFT The pitcher of *Sarracenia oreophila* dies back, and the whole leaf can be pulled out carefully from the base, leaving the sickle-shaped winter leaves.

CENTRE Winter leaves of *Sarracenia flava* are sword-shaped and can be left on the plant.

RIGHT *Sarracenia purpurea* leaves can be left until they die back completely, usually in the spring.



CLOCKWISE FROM
TOP LEFT:

A large *sarracenia*
ready for dividing.

Remove the
plant and wash
the potting mix
away to expose its
structure.

Individual growth
points can be sev-
ered as shown.

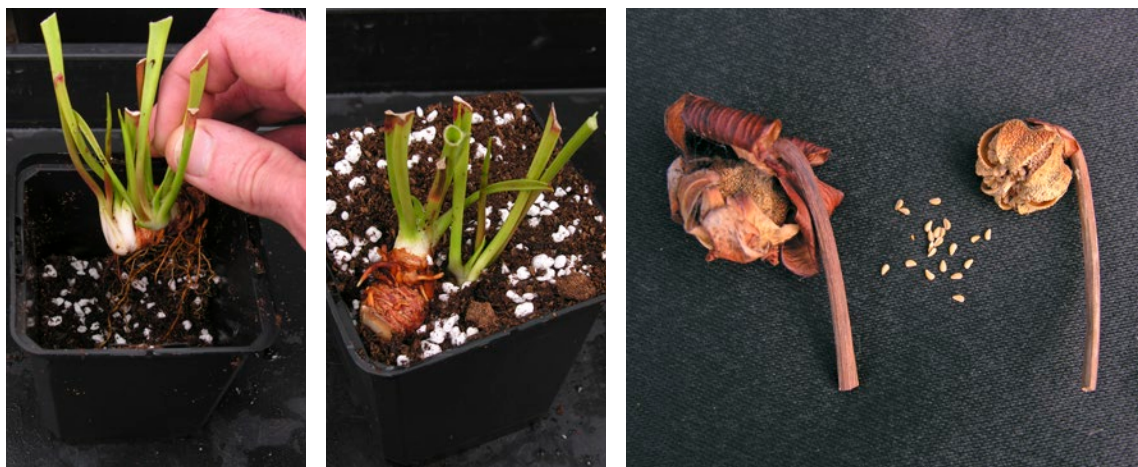
Individual rhizome
cuttings and the
remainder of the
rhizome.

The rhizome can
be cut into lengths
to be used as cut-
tings, discarding
the oldest brown
portion.

After cutting back dead leaves on those plants that require it, allow the plants to rest somewhere cold. If they are under cover, keep them damp rather than wet, and if they are in an entirely unventilated environment, be sure you have removed all dead material. Do keep an occasional eye on plants, as the effects of drying out can be surprisingly sudden and go unnoticed during the colder months.

Plants that live their lives permanently out of doors will have a somewhat shorter growing season than those afforded the protection of a greenhouse, even an unheated one. The subtle differences in bloom times in a greenhouse become much more exaggerated outside, where temperature swings are wider. In slightly warmer environments, and certainly in the native habitat of *Sarracenia*, spring will be heralded by the return of warm weather, enabling plants to commence growth.

Whatever container you choose, you will need to plant *Sarracenia* specimens in an equal mix of peat moss and perlite. If you are growing the plant as a pond marginal, a covering of washed, coarse gravel will prevent the perlite from being flushed out of the potting mix and across the pond's surface.



PROPAGATION

There are two good methods of propagating *Sarracenia*—one fast (by division), and one somewhat slower (by seed).

Being rhizomatous, sarracenias will begin to divide once mature and of a good size. This manner of propagation results in adult plants straight away, and spring is the time to repot and divide your plants. It's ideal to get this done before emerging flowers are 1 in. (2½ cm) in height, because they are brittle when first developing and vulnerable to breaking off during the procedure.

Remove the plant from its pot by turning the container upside down and squeezing its sides to loosen the plant and gently shake it free. It should come out as a single pot-shaped root ball. Larger plants will require some brute force, and those which have altered the shape of their quarters may require the pot to be cut off. Be careful doing this; pots tend to yield suddenly, and it's easy to run the knife through your hand as well as the plastic.

Once the plant has been released, loosen the root ball and shake the potting mix free. You may wish to wash off the rest in a bucket, especially if this is the first time you have divided a plant, as it will help you see the plant's structure more easily.

LEFT The potted division. Note the depth of the rhizome.

CENTRE When potting, note the position of the cutting, with the growth point facing toward the middle of the pot.

RIGHT Two *Sarracenia* seed capsules, the one on the right dissected to show the seeds within.

With the plant exposed, evaluate exactly what to split off. You will notice individual growth points on the ends of old rhizomes. These rhizome sections can be 3 to 4 in. (7½ to 10 cm) in length, depending on the time the plant has been in the pot. If a growth point is young, it may have little or no rhizome behind it, but it can still be detached as long as there are a few roots attached.



Year-old *Sarracenia* plant seedlings.

Using a sharp pair of pruning shears, cut off the rhizome sections, allowing if possible at least 1 in. (2½ cm) of rhizome with each growth point. Once all the growth points are removed, you will be left with a mass of old rhizome sections. Bear in mind that as one end of the rhizome grows and develops, the other end is dying back, so start at the rear, cutting through incrementally until you hit live, white tissue.

These live sections can then be cut into lengths of at least 1 in. (2½ cm) and treated as cuttings; they will invariably sprout new growth in their first year. Just remove the roots to 1 in. (2½ cm) and insert in a seed tray

of standard potting mix for *Sarracenia*, or keep the roots and plant the cuttings in pots. Keep the cuttings away from fierce heat until they have sprouted.

If you are repotting a plant that has outgrown its container and are simply dividing it, follow the same method as just stated, though you will probably find it easier to physically break it apart to start. This may require some considerable effort on your part; a sharp serrated knife or pruning shears can help. Once divided, remove the old, dead back sections of the rhizome, and while it is exposed, remove any leaf bases.

The live divisions—that is, those with a live growth point and split plants—can be potted up into containers. Remember that these can be tall plants, and the roots act as

an important anchor to secure them in the ground. Place a 1-in. (2½-cm) layer of potting mix in the base of the container. Now hold the plant in the pot, allowing the roots to touch the bottom if they are long enough, but keeping the rhizome at ground level. This is important; they don't like to be buried—with the exception of *Sarracenia minor* and *S. oreophila*, both of which should be buried to around 1 in. (2½ cm) under the soil surface if you are repotting plants with growth points intact, or on the soil surface if you have rhizome cuttings. If in doubt, just position them at the level they were previously. As they continue to grow they will find their own level.

At this point, it's helpful to consider the direction in which the plant will grow. Remember, the rhizome is a horizontal stem that travels along the ground in the direction of the growth point. When you position your plant, always ensure that you have the rhizome end toward one edge of the pot, but not touching it, to allow the plant room to grow and develop, and also to ensure it can remain in its pot for as long as possible.

Fill the container halfway with potting mix, giving the pot a tap to shake the mix through the roots. Then use the fingers of your free hand as well to push the mix down and through the roots. Continue this process until the pot is full and the potting mix is firmed down, without using excessive force.

The other method of propagation is via seed. This method can produce a large number of plants, can be fun (especially if you are creating hybrids), and is easy. But you must be prepared for a long process and therefore patience is required. Collect ripe seed in the autumn when the swollen seed capsules are dry and often split open. Either surface sow them immediately and keep in a cold greenhouse or similar over winter, or store them dry in the fridge until March. Sow onto the same potting mix as the adult plants and germination will occur in the spring: two small seed leaves first, then tiny hollow pitchers to about ½ in. (1 cm) in height.

As seedlings, all sarracenias look the same, so don't be concerned if they bear little resemblance to the adult plants you were expecting to see. Remember, they increase in size in stages each year, becoming progressively larger until they reach maturity. For a species this is five to eight years, three to five for a hybrid. Leave the seedlings for two to three years in the seed tray before pricking them out and into small pots no larger than 3 in. (7½ cm) in diameter. Potting them into larger pots will not speed up the process. Treat seedlings in the same way as adult plants.



Sarracenia alata
flowers.

RIGHT *Sarracenia alata* var. *alata*, the typical form of the species.



Plant Suggestions

Sarracenia alata

PALE PITCHER

Sarracenia alata is one of a couple of plants which in my opinion are underrated. A prolific devourer of wasps, it is a variable species which has recently been reclassified into six distinct varieties, (based on stable colour variation) and a form, represented by an all-green, anthocyanin-free plant, *Sarracenia alata* f. *viridescens*. The different varieties work well together with their contrasting colours, and the finer forms of some of the varieties work to highlight and frame larger species in a display. These narrow, elegant pitchers are typically up to 24 in. (60 cm) in height, occasionally reaching as high as 39 in. (100 cm), though these are the exceptions. The beautiful, pale yellow flowers, produced before the pitchers, are approximately half the height and 3 in. (7½ cm) across. Petals occasionally wear a very slight brush of red.

Sarracenia alata var. *alata*, the typical form, boasts beautiful apple-green leaves, touched with fine purple filigree veins. Pubescent forms which wear a coat of fine velvety hair are common, and add to the interest.



Sarracenia alata
var. *atropurpurea*.

Sarracenia alata var. *atropurpurea* is the all-red variety, and requires strong light to colour well. A stunning individual; its pitchers are gradually suffused with a solid crimson colour over the season.

Sarracenia alata var. *cuprea* is at first glance the same as *S. alata* var. *alata*, but differs in that it produces a copper-coloured lid, sometimes accented with pink.

Sarracenia alata var. *nigropurpurea*, the so-called black-tubed *S. alata*, requires good light levels to colour well; the exterior of the pitcher turns a dark purple-black on the

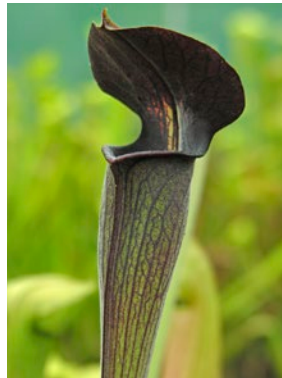
CLOCKWISE FROM
TOP LEFT:

Sarracenia alata
var. *cuprea*.

Sarracenia alata
var. *ornata*.

Sarracenia alata
var. *rubrioperculata*.

Sarracenia alata
var. *nigropurpurea*.



upper half. The interior of the mouth is often darker than the rest of the leaf. Some forms can be exceptionally tall; others bear a pubescence.

Sarracenia alata var. *ornata* is the elegant, heavily veined form, bearing a covering of fine reticulate veins over the upper half of the pitcher and inside the mouth. Its background is bright green, which contrasts and lifts the veining perfectly. Although it often has the red lid of *S. alata* var. *rubrioperculata*, the intense veining confirms its identity.

Sarracenia alata var. *rubrioperculata* has a wide range of veining variability, but is not as heavily veined as *S. alata* var. *ornata*, and is set apart by the presence of a red colouration on the underside of the lid. In many, this is restricted to the lid and ends abruptly; in others, the colour extends into the pitcher throat.

Sarracenia flava

YELLOW TRUMPET

If I had to recommend one carnivorous plant, it would undoubtedly be *Sarracenia flava*. Big, brash, confident, and easy to please, this stalwart should be your first port of call (or second if you've killed your Venus flytrap and don't want a *Drosera capensis*). In a display of any kind—pond, bog garden, greenhouse, or conservatory—this plant will give you both structure and bulk. As with *Sarracenia alata* it is divided, this time into seven distinct varieties governed by colour and patterning. There is also an all-green, anthocyanin-free form, *S. flava* f. *viridescens*. The flowers are the largest in the genus, sulphur yellow and up to 4 in. (10 cm) across, with long petals of similar length. They sit atop sturdy stems which can be anything up to 39 in. (100 cm) in height, towering above some other species. Pitcher height varies greatly. One of the chief attributes of this species is its vigour, with most varieties forming a dense clump over several years. A typical plant will divide roughly once per year, with each growth point capable of producing a flower and four to six pitchers. Dividing every three to four years will maintain this vigour. The red-tubed forms seem to divide more slowly and produce a sparser, more open plant. Prior to the autumn dieback of the pitchers, a handful of sword-shaped winter leaves usually appear, which can be up to 8 in. (20 cm) in height. These are non-carnivorous leaves and remain on the plant until spring.

Sarracenia flava var. *flava* is the typical form of the species, with light green pitchers, often fluted, which fade to yellow over the season. The name *flava* means yellow. Often this colour change is dramatic and plants can be a lemon yellow by the end of their growing season. The upper section of the pitcher bears a small number of delicate red veins.



The glorious, nodding flowers of *Sarracenia flava* herald the start of spring.

RIGHT *Sarracenia flava* var. *flava*.





CLOCKWISE FROM
TOP LEFT:

Sarracenia flava
var. *atropurpurea*.

Sarracenia flava
var. *flava* 'Maxima'.

Sarracenia flava
var. *maxima*.

Sarracenia flava
var. *cuprea*.



Sarracenia flava
var. *ornata*.

Plants vary in height, typically to around 24 in. (60 cm), but up to 39 in. (100 cm). A cultivar of *Sarracenia flava* var. *flava*, 'Maxima' is a glorious monster with correspondingly tall flowers preceding the leaves. It carries the standard vein patterning, and was named for its vigour and size. A note of caution: don't confuse this cultivar with *S. flava* var. *maxima*, which has no leaf veining.

Sarracenia flava var. *atropurpurea* is the rarest of the varieties, and perhaps the most intensely beautiful. Its leaves develop a solid background of plum red, which in good light covers both the exterior of the leaf, including the lid, and the interior. Light is the key to achieving full colouration; lower light levels will produce little more than a reddish blush.

Plants can be large, up to 32 in. (80 cm) in height.

Sarracenia flava var. *cuprea* is usually smaller in stature, up to a maximum of 24 in. (60 cm). A distinct copper colour develops over the upper surface of the lid, sometimes looking almost brown. This colour is strongest from spring into summer, often fading prior to autumn dieback. It is a variable plant, with veining being slight to heavy. I have one form which is entirely veinless, with lime green leaves and a copper top—most unusual.

Sarracenia flava var. *maxima* is often tall and elegant, occasionally up to 30 in. (75 cm), with fluted leaves flaring at the mouth, though it can also be shorter and stockier. This veinless, all-green variety creates a beautiful contrast when grown in conjunction with the red-tubed forms. Note: do not confuse this with the rare anthocyanin-free clones of the same name, nor with the similarly named cultivar *S. flava* var. *flava* 'Maxima'.

Sarracenia flava var. *ornata* gets its ornate reference from the heavy veining across the upper third of the leaf and in the throat.

This can be extreme, with the interior of the throat sometimes developing a solid red or purple suffusion. Similar in height and stature to *S. flava* var. *cuprea*, this variety possesses a variability that sets it apart from others. This is one of my personal favourites.

Sarracenia flava var. *rubricorpora* is another red-tubed plant (*rubricorpora* means "red body"). It develops a solid plum-red colour in good light, though its lid and interior remain green and veined—a startling contrast. Though this variety typically grows to



Sarracenia flava
var. *rugelii*.

LEFT *Sarracenia*
flava var. *rubricor-*
pora.

around 24 in. (60 cm), larger forms may reach over 32 in. (80 cm). Sometimes not dividing as rapidly as other varieties, it can be rather sparse, resulting in an open plant that showcases individual leaves. In displays, highlight this feature by positioning it in front of denser green plants.

Sarracenia flava var. *rugelii* is a variable plant in size and stature; either short and stocky or more tall, elegant, and fluted. At its upper height, as much as 39 in. (100 cm), it is stunning, with a graceful air that some of the other giants lack. Pitchers are veinless, boasting a red splotch within the throat. This colouration is also variable: in some forms it is large and stretches across the throat, in others it is reduced to a thin vertical sliver and may be vibrant red or a dark purple-red. I have one clone which is almost black.



The most elegant and beautiful species in the genus, *Sarracenia leucophylla*.

RIGHT The rare *Sarracenia leucophylla* var. *alba* is still variable and bears veins on the exterior, but produces leaves devoid of any veining in the interior of the mouth.



Sarracenia leucophylla

WHITE TRUMPET

Although I sing the praises of all sarracenias, there are one or two species that stand out. In terms of beauty, the remarkable *Sarracenia leucophylla* wins hands down. As both the common and Latin names suggest, it boasts characteristic white-topped leaves, a rare attribute. It also features an all-green, anthocyanin-free form, *Sarracenia leucophylla* f. *viridescens*.

This is a variable species, with individuals of many sizes and patterns. The confusing array is further complicated by the presence of hybrid plants where the natural range overlaps with other species. Complex back crosses can occur, sometimes making exact identification difficult.



Tall red flowers precede *Sarracenia leucophylla* pitchers in the spring.

OPPOSITE Summer leaves (right) of *Sarracenia leucophylla* are truly spectacular, towering over now-shabby spring pitchers (left) and often twice the width. Their vivid colour is a stark contrast to other tall-growing species.

In its pure form, plants can be large, to over 39 in. (100 cm) tall—bright green breaking into pure white, overlaid with a lace of either green or red veins. In some extreme cases, the white top can be pure and unbroken, the pitchers appearing to glow in the sun. Big red flowers are produced in the spring atop tall stems similar to the leaves in height; multi-crowned plants are an impressive sight.

Sarracenia leucophylla produces an open clump, the rhizomes dividing only occasionally, so a large specimen may consist of only six or seven growth points. It also has a distinct growth pattern: the first pitchers produced after flowering are thin and wiry, often not quite to their full height. These are the spring leaves; once developed, their growth ceases until midsummer, when a second crop is produced.





Sarracenia minor
var. *minor*, the
typical form.

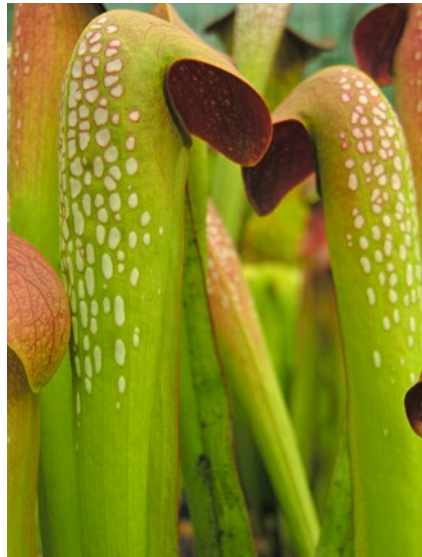
Sarracenia minor

HOODED PITCHER

Sarracenia minor is immediately distinguishable by its unique “hooded” lid which usually overhangs the mouth. It is also furnished with what at first appear to be white spots on the rear of the leaf, but are in fact translucent windows—no doubt to confuse attracted prey. Insects fly toward the windows thinking they are escape routes, but instead hit the rear of the tube, tumbling down into the trap.

LEFT *Sarracenia minor* var. *okefenokeensis*.

RIGHT A comparison of the two varieties: *Sarracenia minor* var. *okefenokeensis* on the left, *S. minor* var. *minor* on the right.



The plant displays a little variation in colour, with some forms flushing red, occasionally with an orange tinge in the autumn. There is also an anthocyanin-free form: *Sarracenia minor* var. *minor* f. *viridescens*. Depending on your locality, this species may be best under cover for the winter in an unheated greenhouse or conservatory.

Plants produce a dense clump over time, and unlike most other species, flower after the production of leaves. The small flowers are a beautiful green-yellow, to only 2 in. (5 cm) across, held below the now-open mouths of the pitchers.

Sarracenia minor var. *minor* is the typical form, a beautiful, densely clumping plant with stocky leaves to around 12 in. (30 cm) in height. Being a shorter-growing species, this is ideal for the front of a mixed display or in a situation where space is limited.

Sarracenia minor var. *okefenokeensis* bears a name that refers to its native range within the great Okefenokee Swamp in the United States. It is similar in all respects to *S. minor* var. *minor*, but its pitchers can reach over 2½ ft. (75 cm). This is a variety that likes to bury its rhizome to aid in the support of its leaves, which can be another 6 to 12 in. (15 to 30 cm) below the surface. Adding this section of the pitcher increases the height further. This plant can become vast; retain control by dividing every three to four years.



Sarracenia oreophila

GREEN TRUMPET

Sarracenia oreophila has the distinction of being the rarest species of *Sarracenia* in its native states of Alabama, Georgia, and North Carolina, and is considered now to be critically endangered.



Sarracenia oreophila var. *ornata*.

OPPOSITE *Sarracenia oreophila* var. *oreophila*.

As with *S. minor*, it has a slightly different growth cycle than other sarracenias: leaves are produced in the spring, prior to the flowers. Blooms are a green-yellow colour, to 2½ in. (6½ cm) across, with short petals held on stems which are always taller than the open pitchers. Pitchers themselves are typically to around 15 in. (38 cm) in height. There are two stable varieties designated according to leaf pattern.

Sarracenia oreophila var. *oreophila* is the typical form of the species, with bright green leaves and a few red to purple veins. Its leaves are often elegant and either stocky or occasionally fluted. Leaves die back in mid- to late summer, earlier if the weather is exceptionally hot, giving it the shortest season of the pitcher plants. Dieback can be rapid and leaves brown to their bases; simply pull them away. Before dieback, a few sickle-shaped winter leaves are produced which sit close to the ground and remain on the plant until the following spring.

Sarracenia oreophila var. *ornata* is a beautiful and moderately rare plant, named for the ornate appearance of the heavily veined leaves. These scarce individuals can be very striking—their colouration immediately sets them apart, making them highly sought after by collectors.

Sarracenia psittacina

PARROT PITCHER

Sarracenia psittacina is in many respects the odd man out of the genus, with a form unlike any of the other species. Ground-hugging rather than upright, its leaves are held flat to



the soil. The structure of the leaves also differs: while characteristically tubular, they are lined internally with long, very pronounced interlocking hairs, forming a one-way route for prey that prevents escape.

The top of the leaf has an inflated dome, with a mouth at its base facing into the centre of the rosette. It is similar in structure to a lobster pot, and works in a similar way—crawling insects enter the dome and are guided to the tube, where they are digested in the same manner as other species of *Sarracenia*.

Because of its unique form and often intense colouration, *Sarracenia psittacina* is essential as the frontman in a mixed display. It looks good year-round as it retains its leaves through the winter. Dieback doesn't occur until spring, as new growth emerges. Flowers are small, barely 1 in. (2½ cm) across, but are a rich dark burgundy colour. It doesn't flower as freely as other species, so do not expect them every year.

This is a species I would not recommend keeping outside year-round. Rather, afford it a little protection over winter in a cold greenhouse or similar. It is divided into two varieties, each with an anthocyanin-free form.

The entrance to the lobster pot-like trap of *Sarracenia psittacina*.

LEFT The small flower of *Sarracenia psittacina*.



Sarracenia
psittacina var.
okefenokeensis.

Sarracenia psittacina var. *psittacina*, the typical variety, produces leaves to around 3 in. (7½ cm) in length, of variable colour, with individuals of pale to intense red, and even occasionally orange-flushed specimens. Over time it forms a dense clump.

Sarracenia psittacina var. *okefenokeensis* is similar to the typical form in all respects except size—leaves are up to 6 in. (20 cm) long, and domed hoods can be 2 in. (5 cm) across. Hailing from the Okefenokee Swamp in the United States, this plant imparts an alien-like quality when planted among mosses.



Sarracenia purpurea

PURPLE PITCHER

Another unique, low-growing species for the front of a display, but one which also makes an ideal stand-alone specimen. *Sarracenia purpurea* is short and squat, and differs from most in the genus in that the pitcher's mouth is open, designed to collect rainwater under an often large and undulating frilled hood.

Plants are clump forming, with a large, mature plant being an impressive sight—especially in the spring, when they fire out typically red-petalled flowers that can be up to 3 in. (7½ cm) across. Leaves are typically 4 to 6 in. (10 to 15 cm) long and vary in shape. They are retained through the winter, with old growth dying off in the spring. Allow complete dieback, then pull out dead growth, using one hand to support the base of the plant to avoid snapping the delicate rhizomes.

Sarracenia purpurea subsp. *purpurea* is the northern subspecies, and has the accolade of being the hardiest of all sarracenias, with its natural range extending across much

The flower of *Sarracenia purpurea* subsp. *venosa*.

CLOCKWISE FROM
TOP LEFT:

Anythocyanin-free *Sarracenia purpurea* subsp. *purpurea* f. *heterophylla* (left) and *Sarracenia purpurea* subsp. *purpurea* (right).

Anthocyanin-free *Sarracenia purpurea* subsp. *venosa* f. *pallidiflora* (left) and *Sarracenia purpurea* subsp. *venosa* (right).

Anthocyanin-free *Sarracenia purpurea* subsp. *venosa* var. *burkii* f. *luteola* (left) and *Sarracenia purpurea* subsp. *venosa* var. *burkii* (right).

Unlike the blooms of others in the species, *Sarracenia purpurea* subsp. *venosa* var. *burkii* has a pink flower.



of Canada and naturalized populations in Ireland, England, and even Switzerland. The leaves are usually rather slender, and may be solid red, veined, blushed orange, or any combination of these. An anthocyanin-free plant, *S. purpurea* subsp. *purpurea* f. *heterophylla* is lime green, a striking contrast.

Sarracenia purpurea subsp. *venosa* is the southern form, found from the state of New Jersey southward. It is a stockier plant in all respects, with a wider pitcher and a more open, flared mouth. Varying degrees of attractive veining are present, and can become a solid pink-red in good light. There is also an anthocyanin-free plant, *S. purpurea* subsp. *venosa* f. *pallidiflora*.

To many, the most beautiful expression of the species is pink-flowered *Sarracenia purpurea* subsp. *venosa* var. *burkii*, a stocky variant with a bulbous pitcher and a distinctive, thick lip across the mouth. An anthocyanin-free plant has delicately pale yellow-green leaves, and is blessed with perhaps the longest name of any carnivorous plant: *S. purpurea* subsp. *venosa* var. *burkii* f. *luteola*. It's scarce, but worth growing for the name alone.

Sarracenia rubra

SWEET TRUMPET

I have a soft spot for *Sarracenia rubra* because it is often overlooked due to its smaller stature and growth habit. To me (always on the side of the underdog) this is a shame, as it is a beautiful plant and deserves a second look. It is a favourite for a couple of reasons. One, it is the only species to produce more than one flower from each growth point, a characteristic which on a mature plant can result in a large and impressive number of blooms in the spring. Second, the flowers are among the smallest in the genus, dark red in colour and often only around 1 in. (2½ cm) across on dainty stems, their modest size affording them a delicate elegance against the more substantial flowers of larger species. They possess a charm and grace absent from their ostentatious cousins.

Sarracenia rubra follows the usual pattern of flowering prior to leaves opening. There are two bursts of growth: slender and at times floppy leaves appear in the spring, and a second round of taller, stockier leaves are produced in the summer, lasting well into winter. There are five subspecies of *Sarracenia rubra*, and plants grown or positioned together offer a wide selection of colours—a good display can be made just with representatives of this single species.



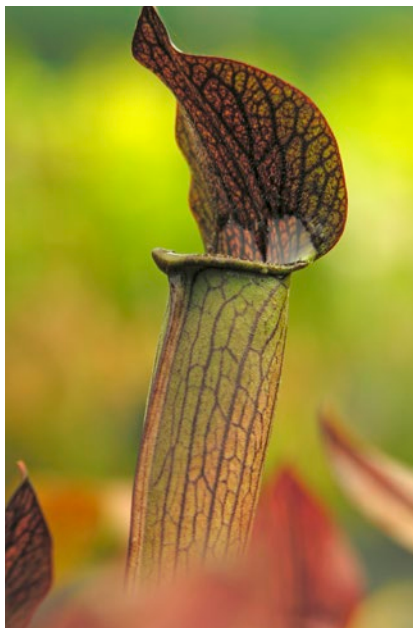
Samples of the five subspecies of *Sarracenia rubra* (from left): *S. rubra* subsp. *alabamensis*, *S. rubra* subsp. *gulfensis*, *S. rubra* subsp. *jonesii*, *S. rubra* subsp. *rubra*, and *S. rubra* subsp. *wherryi*.



Together, *Sarracenia rubra* subspecies add a splash of colour and vibrancy to an autumnal morning.

Sarracenia rubra subsp. *rubra* is the typical form, a slim and densely clump-forming plant, generally apple green with purple veining. Occasionally rather attractive red individuals are found. It is small in stature, the tallest plants generally under 12 in. (30 cm).

Sarracenia rubra subsp. *alabamensis* has the largest of the summer pitchers, the tallest up to 20 in. (50 cm). It is a vibrant green and often sports a good cover of reticulate purple veining in the throat, under the large lid.



LEFT The delicate flowers of *Sarracenia rubra*, nodding in the greenhouse.

RIGHT *Sarracenia rubra* subsp. *gulfensis*.

Sarracenia rubra subsp. *gulfensis* is a more variable plant, producing tall leaves to around 20 in. (50 cm). The top section of the often olive-green pitcher bulges slightly, but is not as wide as *S. rubra* subsp. *alabamensis*. Leaves are occasionally shaded an attractive red, with copper-coloured tops. There is also an anthocyanin-free form, *S. rubra* subsp. *gulfensis* f. *luteoviridis*, which often bears white patches over the upper quarter of its leaves.

Sarracenia rubra subsp. *jonesii* is another tall, variable plant in the wild, but comparatively few clones of this scarce plant are in cultivation. It too bears a pitcher which slightly bulges at the top, and those likely to be encountered are often ornate with good veining. An anthocyanin-free plant is *S. rubra* subsp. *jonesii* f. *viridescens*.

Sarracenia rubra subsp. *wherryi* is my personal favourite of the subspecies. It is smaller in stature, the summer leaves generally only up to 9 in. (25 cm) high, and it often develops a wonderful, subtle colour which can include hints of copper, red, and pink. These pitchers are usually slightly pubescent, giving them a felty, tactile nature.

A mixed display of carnivorous plants by the author, with a variety of *Sarracenia* species and hybrids.



Sarracenia hybrids

This is where things get messy, and neatly compartmentalized species give way to a dazzling array of hybrid plants. As we've mentioned, a hybrid is a cross of two plants of different types, and in their simplest form they are known as primary hybrids—that is, a cross between two species. These occur in the wild where the ranges overlap, but can also be created in cultivation.

Hybrids can introduce an extra element of vibrancy and form to any display of *sarracenia*s, and serve to lift the colours of the species. They also demonstrate what is known as hybrid vigour—the increased vitality that the offspring of two parents has when it comes to growth rates, size, and often longevity of leaf life.

Sarracenia $\times$ *mitchelliana* is a great plant to add intermediate height between the smaller species and taller specimens. It and the similar *S.* $\times$ *catesbaei* bring a different shape, as their lids (from the *S. purpurea* parent) are upright and open. *Sarracenia* $\times$ *mitchelliana* is also serrated and often heavily veined from the *S. leucophylla* influence.

Sarracenia $\times$ *moorei* 'Adrian Slack' is one of those highly sought-after plants, named after the man responsible for bringing carnivorous plants to popular cultivation in the 1970s and '80s. It is a beautiful plant with vivid red-pink colour in the mouth and a white lid, carefully drawn with heavy and deliberate veins.

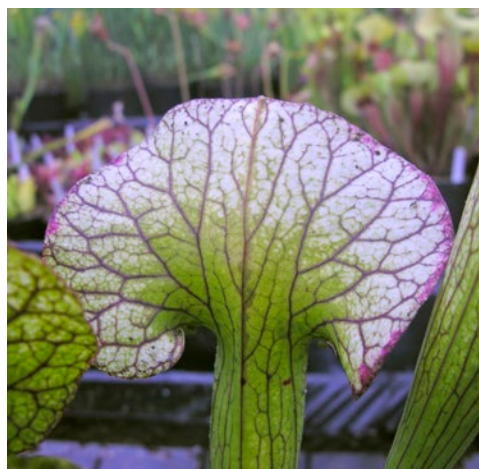




LEFT *Sarracenia*
'Joyce Cooper'.



CENTRE *Sarracenia*
xmoorei 'Brook's
Hybrid'.



RIGHT *Sarracenia*
'Constance Healy'.

OPPOSITE *Sarracenia*
xmoorei 'Adrian
Slack'.

Sarracenia xmoorei 'Brook's Hybrid' is a plant which has been in general cultivation for a number of years. Essential for sheer size (reaching over 39 in. [100 cm] in height regularly), its colour is predominantly green, with a slight degree of white speckling on the lid and in the throat. It is lightly veined in red, and also has a remnant patch of solid red in the throat from its *S. flava* var. *rugelii* parent.

Sarracenia 'Constance Healy' is one of two plants I named after my grandmothers, who did so much to encourage my appreciation of the botanical world. A complex cross between a red form of *S. xatesbaei*, and *S. xmoorei* 'Brook's Hybrid', the plant attains a height of around 12 in. (30 cm). It has an apple-green pitcher with fine red veining in the upper half, giving way to a lid that can be over 4 in. (10 cm) wide, where the green breaks into white while retaining the veining. Its large flowers have broad, dark pink petals.

Sarracenia 'Joyce Cooper' is the cultivar named for my other grandmother, and is from the same cross (*S. xatesbaei* and *S. xmoorei* 'Brook's Hybrid'), which demonstrates just how variable offspring can be from complex crosses. It is of a height similar to 'Constance Healy' but produces slimmer pitchers with narrower lids. Colouration is unique, with the coloured leaves from its *S. xatesbaei* parent presenting as a mottled effect. Leaves are orange. As it develops, the veins on the outside of the lid are reversed, appearing green against an orange background.

Examples of *Sarracenia* Primary Hybrids

Bear in mind that these hybrids are all fertile, and can hybridize with each other to create ever more elaborate and complex crosses. With this in mind, we'll just consider a handful of interesting plants.



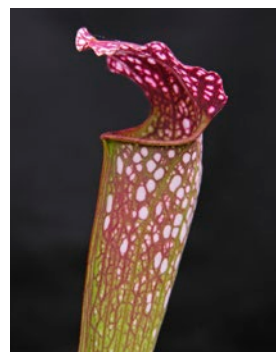
Sarracenia xareolata, a cross of *S. leucophylla* and *S. alata*.



Sarracenia xcatesbaei, a cross of *S. purpurea* and *S. flava*.



Sarracenia xchelsonii, a cross of *S. purpurea* and *S. rubra*.



Sarracenia xexcellens, a cross of *S. minor* and *S. leucophylla*.



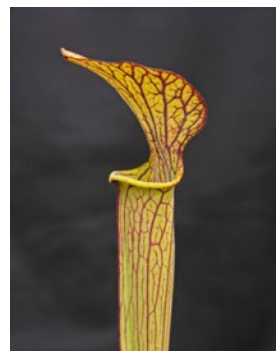
Sarracenia xexornata, a cross of *S. purpurea* and *S. alata*.



Sarracenia xmoorei, a cross of *S. leucophylla* and *S. flava*.



Sarracenia xmittchelliana, a cross of *S. leucophylla* and *S. purpurea*.



Sarracenia xpopei, a cross of *S. flava* and *S. rubra*.

Utricularia

BLADDERWORT



Utricularia campbelliana, growing among moss on tree branches in Venezuela.

TOP *Utricularia vulgaris*, an aquatic bladderwort. Note the winter resting buds developing at the ends of the thin branches.

Bladderworts represent one of the largest genera of carnivorous plants, with some 230 species. They have worldwide distribution and like the droseras are found on every continent except Antarctica. This is in itself a remarkable achievement, but when combined with their diversity and the fact that they possess the fastest-moving structures and most highly sophisticated level of natural engineering in the plant kingdom, the genus *Utricularia* becomes truly awe-inspiring. From a cultivation aspect, the bladderworts are grown primarily for their often incredible, orchid-like flowers, which range in size from a few millimetres to over 2 in. (5 cm) across.

The variability and adaptations found within the genus are vast, but we'll keep things simple by following the traditional division of bladderworts (at least for cultivational purposes) into three groups: aquatic, epiphytic, and terrestrial.

Aquatic species are found across Europe and in other parts of the world, existing as free-floating stems and branches. In temperate regions they lose their growth and form small spherical buds, which sink to the bottom of their ponds to survive the cold

of winter, then float to the top in the spring.

Epiphytic species are typically found living in mosses, either at ground level or higher up on the trunks and branches of trees, generally in tropical areas. There the risk of drying out is minimal due to the high level of rainfall.

Terrestrial plants, which make up the largest number of species, are found in wet soils, sometimes as evergreen perennials. In other examples, they exist as annuals in seasonally wet areas, surviving as seed during the dry period of the year.

Whether aquatic, epiphytic, or terrestrial, the bladders themselves (as they are called) all require the presence of water to function and trap their prey. Bladders are small,



generally oval structures which are hollow and have an entrance door at the narrow end, creating a seal and holding a vacuum within, giving the trap a lean, pinched appearance. Size varies greatly, from around $\frac{1}{50}$ in. ($\frac{1}{2}$ mm) to the largest at around $\frac{1}{2}$ in. (1 cm) in diameter. When an insect touches a trigger hair, it causes the door to open, allowing the walls of the trap to spring out and suck the water and insect inside before reclosing—a process which takes less than two thousandths of a second! Once inside, the water is then pumped out of the trap, leaving just the insect within to be digested.

A close-up image of botanical engineering at its finest and most extreme: the traps of *Utricularia reniformis*.

LEFT *Utricularia reticulata*, a typical terrestrial species with small leaves pressed to the soil surface.

CULTIVATION

As with *Pinguicula*, it is wise for cultivation purposes to approach *Utricularia* in the species groups discussed: aquatic, epiphytic, and terrestrial. Of course, a large and diverse genus such as this will have exceptions to the rule, but we are concentrating on the common species.

AQUATIC SPECIES Whatever their origins, all aquatic species of *Utricularia* must be submersed to function and trap prey. Their meals consist of tiny aquatic organisms such as daphnias, so these are not the plants to use for clearing wasps from the greenhouse.

A couple of temperate aquatics are ideal for growing in your garden pond, especially if it's a wildlife pond free of destructive fish (and unnecessary nutrients). They will tolerate a winter minimum of -4°F (-20°C). You can generally leave the plants to their

The fine stature of the terrestrial species makes them ideal to use as accents, such as with bonsai plantings. Left to right: *Utricularia bisquamata* 'Betty's Bay', *U. sandersonii*, and *U. livida*.



own devices; by their very nature they will grow in the summer and die back and sink in the winter. Not particularly inspiring, but interesting just the same. Other species from warmer climes can be grown in a tank or small vessel in the home or terrarium. The biggest issue with these containers is a build-up of destructive algae—virtually unavoidable in such settings, and requiring an ongoing investment of time, effort, and attention.

EPIPHYTIC SPECIES Epiphytic utricularias grow within mosses and the like, always on another living plant—though unlike a parasite, not to the host's detriment. No carnivorous plants are parasitic.

Regarding cultivation, I recommend Zone 11, where plants are hardy to 45°F (7°C). The key distinction in growing epiphytic species is in the potting mix. I like to keep my epiphytics in pots with the lower 50 percent plain peat, and the remainder topped with a mix of sphagnum moss and orchid bark. I fill the lower section with peat moss because sphagnum placed there would break down and produce an offensive smell in a very short time.

Keep plants wet and in good light, affording some shade from the strongest sun. In the winter, allow them to dry a little so they're damp (with the winter minimum of 45°F [7°C] mentioned previously). In temperate climates they tend to lose their leaves, regrowing in the spring.

Epiphytic bladderworts are also ideal for terrarium cultivation. This environment will widen your choice of species, and in it, plants can be kept warm and in growth year-round.

TERRESTRIAL SPECIES This group offers the largest number of plants available to grow on a windowsill, or even as part of a larger display. All thrive in equal parts peat moss and lime-free horticultural sand, set permanently in a dish of rainwater. In summer, this water level can be as high as the soil surface; less water is required in winter. Never allow these plants to dry out—they consist of extremely fine strands of growth which will die quickly if desiccated.

Terrestrial utricularias are not particularly fussy about light levels, and this opens them up to succeed in different environments. Outside plantings can be grown in Zone 11, where they will tolerate 45°F (7°C). Sunny and shady greenhouses are fine, as are sunny and shady windowsills—a good choice for low-light windows. As small container-grown plants (shallow dishes work well), they are almost botanical ornaments. Use them to adorn tables and such, where their small flowers can be appreciated. Their modest stature also makes them suitable as accent plants for other specimens such as bonsai, the delicate nature of terrestrial utricularias a perfect contrast to the solid nature of trees and other bonsai forms. In terrariums, keep them potted to curb their wandering nature. Here, you will be able to grow a plethora of tropical species which will appreciate the warmth and reward you with year-long flowers.



Divisions of utricularias. The epiphyte *Utricularia reniformis* on the left, terrestrial *U. livida* on the right.

PROPAGATION

There are two options when it comes to propagating bladderworts. When beginning with a new species, seed is often the only way to go. Because of the wide variation in their native habitats, however, it is difficult to give one-size-fits-all advice on how to germinate them. Some have habitats that dry out on an annual basis and will only grow after a period of hot desiccation (the complete opposite of sarracenias and other temperate plants). Others need warm and wet conditions. One or two are shed as living, green seeds with a visible embryo and need to hit water immediately. As a rule of thumb, though, they all need to be sown and kept very wet, and with a little warmth they will germinate in around four weeks if viable. A thorough daily spray from a hand-held mister will help.

If you already have a particular plant and wish to propagate it, forget seed, as many do not self-seed anyway. (Believe me, this is a blessing, as the ultra-fine seed tends to blow around in the greenhouse, infecting other pots.) Division is quick and easy. With terrestrial species, this is as straightforward as either taking the plant out of the pot and splitting it into sections, or cutting a section at least ½ in. (1 cm) in diameter and planting it in the same potting mix as the adult plant. You will be surprised how quickly new plants will take hold. With epiphytic species, the principle is the same, but a little more care is required. They are larger plants, often with thick, fleshy roots, and not as neat and compact as terrestrial species, so you will need to divide carefully. Ensure that a good section of roots is in each division, and simply replant in the same potting mix as the adult plant. Aquatic plants can be simply pulled apart and dropped in water.

Utricularia vulgaris.
Note the structure
of the traps and
the developing
winter resting bud
(turion) to the left.



Plant Suggestions

AQUATIC SPECIES

Utricularia vulgaris

Utricularia vulgaris, the common bladderwort, is a vigorous and widespread plant found across Europe and Asia as well as the UK (though scarce there). This plant is best suited to a garden pond—specifically a wildlife pond without destructive fish that are likely to eat the plant's winter resting buds (turions). Simply drop the plant into the water and let it do its thing. Occasionally, it produces the most beautiful yellow flowers, to ½ in. (1 cm) across, held to 4 in. (10 cm) above the water surface.



LEFT Flowers of *Utricularia alpina*.

TOP RIGHT The kidney-shaped leaves of *Utricularia reniformis*.

BOTTOM RIGHT *Utricularia reniformis* flower.

EPIPHYTIC SPECIES

Utricularia alpina

A beautiful species found in northern South America and the Antilles, *Utricularia alpina* produces broadly spear-shaped leaves to around 4 in. (10 cm) in length, which are held upright. The large white flowers with a yellow area on the lower lobe are unmistakable. It forms tubers to enable it to survive dry periods, and is a perfect candidate for the terrarium.

Utricularia reniformis

A favourite plant, *Utricularia reniformis* is also from northern South America, and one of the largest as well. Bright green, kidney-shaped leaves grow to 4 in. (10 cm) across, held aloft on wiry red stems. The flowers, reminiscent of an orchid, are to 2 in. (5 cm) wide and of a pale violet colour, the lower lobe furnished with two vertical yellow stripes. This can be a large plant, ideal for the terrarium or greenhouse.

LEFT *Utricularia bisquamata* 'Betty's Bay'.

RIGHT *Utricularia* sp. "Kerala."



TERRESTRIAL SPECIES

Utricularia bisquamata

Utricularia bisquamata is probably the most common bladderwort of all. This South African plant is particularly vigorous; in most forms it will rapidly self-seed and become a nuisance, albeit a nuisance with charm. It is exceedingly variable, with most forms being small and perhaps a bit innocuous. The best form to grow has been elevated to cultivar status, *Utricularia bisquamata* 'Betty's Bay': a fine, self-sterile clone with large flowers to $\frac{1}{3}$ in. (8 mm) across, and a pale purple lower lobe, darker at its upper edge before giving way to a vivid yellow. Suitable for the windowsill, greenhouse or conservatory.

Utricularia sp. "Kerala"

Utricularia sp. "Kerala" is an as-yet-unnamed species found in the Indian state of Kerala, and therefore ideal in the terrarium. I find this plant both prolific and extremely floriferous, making it ideal for the beginner. It produces many delicate, pale pink flowers touched on their lower lobe with a yellow patch on the upper section atop a darker purple line. The upper lobe is of the same colour, and the pointed white spur extends downward. These are produced on stems to around 4 in. (10 cm) in height, with several flowers open at any one time on each scape. While this plant, like other terrestrial species, tolerates temperatures to 45°F (7°C), it prefers warmer conditions.



LEFT *Utricularia livida* (pink-purple clone).

RIGHT *Utricularia parthenopipes*.

Utricularia livida

Utricularia livida is an interesting and variable plant found in both Central and South America and in Africa. The flowers can be pale violet and white in some forms, a darker blue in others, held above broad, apple-green leaves. The flowers open singly one above another, with as many as eight to ten on each fine scape.

Utricularia parthenopipes

A South American species with a charm nearly as elegant as its name. Although *Utricularia parthenopipes* will tolerate the same temperatures as the others listed, it does better in the warmer confines of the house or terrarium. Its white flowers, which are up to ½ in. (1 cm) long, are touched with a vivid yellow patch at the top of the lower lobe, and a cluster of deep purple veins on the upper. In comfortable conditions it can flower prolifically, seemingly producing viable seed, so beware.

Utricularia prehensilis

Utricularia prehensilis is a stunning plant with sulphur-yellow flowers on tall stems. The stems have the ability to twine, and in the wild, wrap themselves around surrounding

LEFT *Utricularia
prehensilis*.

CENTRE *Utricularia
sandersonii*.

RIGHT *Utricularia
uniflora*.



grasses, always in a counterclockwise direction. This is an attribute shared with around twenty species, all but one twining in the same direction. Not content to stay put, it is often seen escaping from the base of its pot. Flowers are to around ½ in. (1 cm) long with a lower lip that protrudes outward. The strap-shaped leaves are a similar length.

Utricularia sandersonii

One of the most common and recognizable species in cultivation, and for my money, one of the prettiest. *Utricularia sandersonii* produces a profusion of small, paddle-shaped, bright green leaves, and a similar quantity of white flowers up to ½ in. (1 cm) long. They are unusual compared to other species, in that they possess a long, arching spur which reaches forward from the rear to the underside of the flower. Also, the upper lobe is divided into two “ears” which give the flower the appearance of a rabbit. These are touched with a light streak of violet, as is the wide lower lobe. They are produced in profusion, each flower scape carrying around six blooms.

Utricularia uniflora

Utricularia uniflora is an Australian species which, as the name implies, produces its flowers singly on tall stems. These are pink in colour, the lower section fanning out like a skirt, topped with two tiny vertical yellow lines, themselves underlined with a dark pink stripe. The upper lobe is small and pale. The dark stems can be up to 8 in. (20 cm) in height.



TAKING THINGS TO THE NEXT LEVEL

The exquisite
form of *Cephalotus
follicularis*.

At some point, you will begin to tune in to your plants and their particular foibles and habits. You will get the hang of the unique processes they employ to survive and

thrive, and what role you play in their success. As your knowledge and experience grows, you may become ready to take on carnivorous plants that push your ability a little further (we also sometimes refer to this stage of interest as “hooked”).

The three genera that follow should be perfect for that stage of your development as a carnivorous plant gardener. However please heed this warning: although you may be tempted, do not attempt growing these plants until you have had a degree of success with the more common plants from the previous chapter—early failures can be very disappointing. (Trust me, when it comes to cultivation, I and many others have fallen into the carnivorous plant trap of running before we could walk).

Cephalotus

ALBANY PITCHER PLANT

As with *Darlingtonia* and *Dionaea*, there is just one species of the genus *Cephalotus*: *C. follicularis*, and it is the sole representative of its family, the Cephalotaceae. This unique pitcher is unlikely to be confused with any other plant. It is found in a small coastal area near the town of Albany in southwest Australia, where it inhabits open, peaty swamps. The habitat rarely sees temperatures as low as freezing, and the plants are usually found in full sun, but sometimes in shaded areas.

A perennial, its unique appearance makes it highly sought after, a popular choice for collectors. It is a low-growing species which produces two types of leaves. One is a flat, dark green, non-carnivorous leaf. The other is a pitcher, exquisite in both form and design, with a remarkable intricacy. The pitchers are small, the largest being only around 2 in. (5 cm) in length, but with a level of detail generally found only in the genus *Nepenthes*.

It is a rosetted plant which gradually forms a clump from its thick subterranean rhizome, each rosette up to 5 in. (12½ cm) in diameter and consisting of a combination of carnivorous and non-carnivorous leaves. The squat pitchers are attached by a sometimes long stalk to their rear, and are often partly buried to around a quarter of their depth. This is in order to catch crawling insects such as ants. Depending on their location, pitchers can be a range of colours, from green (in semi-shade) to bright burgundy (in full sun). Each is furnished with three substantial ridges, which run vertically up the



A *Cephalotus* plant is perfect in full sun next to a window.

front of the trap, each ridge fringed with long, white hairs. These ridges are dual purpose: they add to the intrinsic strength of the structure, and also guide crawling insects upward toward the mouth, which is guarded by a palisade of glossy red, inward-pointing spines.

A lid overhangs the mouth to avoid the ingress of water. This lid is marked on its lower side by dark red patches interspersed at the margin by translucent windows, perhaps to allow light to reflect on the liquid within. The throat of the pitcher is pale green, and

below the spines it forms a ridge before giving way to the belly of the trap—another barrier to prevent escape from within. Small insects are guided and channeled along the pitcher length by the ridges. Nectar is secreted over the mouth region and acts as a further attractant. Here the prey lose their footing and fall into the trap, where they are digested. The traps have a substantial feel; because of their design they are surprisingly strong, presumably to prevent mechanical damage.

In the spring a somewhat absurdly tall flower scape is produced, up to 24 in. (60 cm) high. It is topped by a cluster of what frankly must be the biggest florific anti-climax in the world of carnivorous plants: small, inconspicuous white flowers with yellow stamens and pink stigmas, around $\frac{1}{6}$ in. (4 mm) in diameter. Several open at once. Although self-fertile, a pollinating agent is required to fertilize the flowers. This results in small, hairy seeds to $\frac{1}{12}$ in. (2 mm) long being produced in the autumn.

CULTIVATION

Cephalotus is one of those genera with a reputation for being difficult in cultivation, though I believe a combination of hard conditions and infrequent repotting goes a long way toward ensuring success.

As with many carnivorous plants, it inhabits a harsh environment in the wild and is adapted to full sun, although as I previously alluded, it will grow in shade. Such sun-restricted conditions, however, result in traps that although larger, are green and somewhat insipid. For this reason I recommend placing it in the sunniest location you have. That said, due to its tolerance of lower light levels, it is a candidate for those shadier windowsills—though I would stop short of placing it in truly shade-dominated window. It is also a good option for the terrarium, especially under lights.



The underwhelming flowers of *Cephalotus*.

Follow the standard regimen of keeping the container in a tray containing 1 to 2 in. (2½ to 5 cm) of rainwater in the summer months, reducing that amount to maintain dampness over the winter without allowing the plant to dry out. Grow *Cephalotus* in Zone 11; an ideal winter minimum is 41°F (5°C), although a cooler location in the house is fine, as this plant doesn't need quite the intense drop in temperature that more temperate species require. *Cephalotus follicularis* is remarkably tough, though; I have frozen them, though I can't endorse such behaviour. Apart from a little leaf damage, they were fine, regrowing in the spring.

Plant in standard-depth containers or similar. Potting mix should be equal parts peat moss and horticultural sand. There is the temptation with a plant whose habit is low to the ground to pot it in shallow containers—a bulb bowl, for example—but avoid this. *Cephalotus* plants like a good depth; their roots are fine and can penetrate deep below the stocky rhizome. This fine constitution results in some fragility, though, and newly repotted plants, especially if they are large, have a tendency to lose a number of roots. The effect is that they appear to sulk somewhat, often dropping their lids over their mouths for a period of two to three weeks. If this happens, place a plastic bag over the plant (which will help reduce water loss), and move the pot to a shadier location until the plant appears to be back to normal. Smaller specimens seem to be more resilient, perhaps as they are easier to handle and repot and lose fewer roots in the process.

PROPAGATION

There are three methods of propagation for the Albany pitcher plant: by seed, rhizome, and leaf cuttings. Seed is a good way of raising multiples of the plant, though it's a little slow. The tiny seeds are best collected in the autumn, when they are shed, and stored in the refrigerator. In the spring, they can be surface sown on the same potting mix as the adult plants, then kept wet and in full sun. Germination occurs in around four weeks. Move the plants on as they develop.

As there is a rhizome on this plant, it is an ideal candidate for division in the spring. This results in adult-sized plants, albeit on a smaller scale, almost immediately. Carefully removing the plant from its pot (bearing in mind my previous cautions), simply break off the individual growth points, along with a portion of the rhizome and roots. Try to retain



the major section of the plant (which you aim to keep), to minimize root disturbance and prevent repotting issues. Plant the divisions separately in the same potting mix. Smaller potted sections appear to be more resilient, perhaps because of their smaller stature. Once wetted thoroughly, they should resume their growth. Keep the divisions out of full sun, under cover in a propagator for a few weeks until established.

The third option, and one which prevents disturbance to the root system entirely, is to take leaf cuttings or pullings. This method utilizes the flat, green, non-carnivorous leaves and is best undertaken in the spring. The leaves should be gripped firmly between the fingers, as low as you can manage, because the trick is to remove the leaf from the rhizome *with* its base, at the end of the stalk. This is where the genetic material (which will produce the new plant) is to be found. Once you have harvested a few (and don't be afraid to take over half of them), fill a container with the potting mix mentioned. Make small holes in the mix with a plant label or similar, and insert the leaves to the depth of the stalk, with the leaf remaining above the soil surface.

LEFT *Cephalotus* divisions. Note the thick rootstock.

TOP RIGHT Leaf pullings from *Cephalotus* plants need to include the paler base of the stem.

BOTTOM RIGHT Push the pullings into the potting mix, up to the point where the leaves begin to flare out.

Water well from above to wash the potting mix around the leaf bases. Keep wet and in a bright position away from scorching sun. New plants can be seen developing in around eight weeks. They should be left in the pot until they are sturdy enough to handle, at which point they can be potted separately.

Heliamphora

SUN PITCHER

Native to those peculiar flat-topped table mountains known as *tepui*s, and their surrounding marshy lowlands, this genus is the South American representative of the family Sarraceniaceae. As little as thirty years ago, only five species were known, so remote are their often highly restricted ranges. In that comparatively short time, their ranks have swelled to include some twenty-four members.

Sun pitchers possess an elegance not so apparent in other plants. They work like, and indeed are similar in design to, the sarracenias, though they appear to be a little more primitive. A pitcher is comprised of a simple leaf, which has been rolled around and attached at the front to form a tube. However, *Heliamphora* is precisely adapted to its unique habitat. The leaf opening is not finished with an overhanging lid, as with the upright sarracenias. Instead, it is furnished with a much-reduced structure, commonly referred to as a nectar spoon, due to its small size. This secretes a sometimes sweet-smelling nectar, which acts as an attractant to passing insects. While drinking, the bugs lose their footing on the slippery surface directly beneath, falling into the water-filled pitcher. There they are broken down by bacterial decomposition.

Plants are generally found growing atop the tepuis, isolated from each other and the surrounding lowlands. It is this isolation which over eons produced the speciation we see today—individual species are often found on only a single mountain. We have a small number of determined botanists and explorers to thank for the relatively recent discovery of so many of these fascinating plants; in the scientists' research, they have often been the first humans to step onto these alien landscapes.

These mountains experience high rainfall, generating their own weather systems as hot lowland air is pushed upward by the sheer sides, to condense over the vast plateaus.



Heliamphora glabra
in habitat, atop
Mount Roraima.

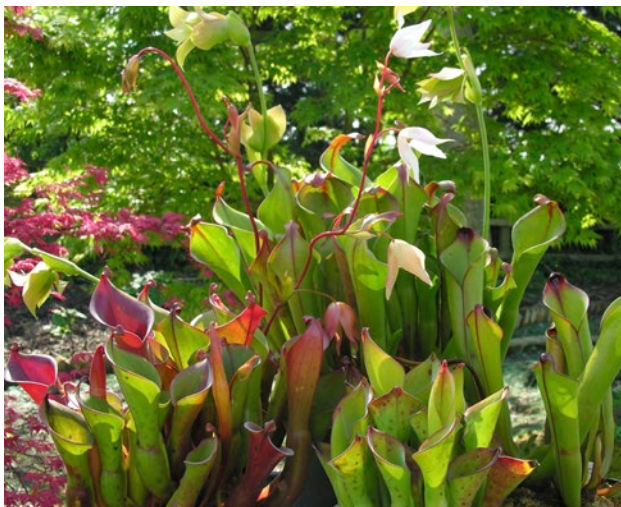
LEFT Two tepuis in
Venezuela: Kuke-
nam on the left,
and the famous
Roraima on the
right.

They are among the wettest places on Earth. Rather than battle to keep their leaves free of excess water, which would flush the contents out, the pitchers freely fill on a regular basis. They do, however, have a mechanism to prevent loss of food items. At the front of the leaf, where the join is, close inspection will reveal either a thin drainage slit extending about a quarter of the way down beneath the mouth, or a small drainage hole. Each option bears a number of short hairs which act as filters, so the excess water can escape, but the prey cannot.

The plants vary widely in height, from around 6 in. (15 cm) in the case of *Heliamphora minor*, up to 13 ft. (4 m) in *H. tatei*, which forms a tall, upright stem topped by a rosette of pitchers. This enables the plant to grow through surrounding scrub. The pitchers are still among the tallest, up to 18 in. (45 cm); they are often fluted and elegant with wide mouths. Between species, plants can be remarkably colourful: some variation of green, red, red and green, and orange is the general range of their spectrum.

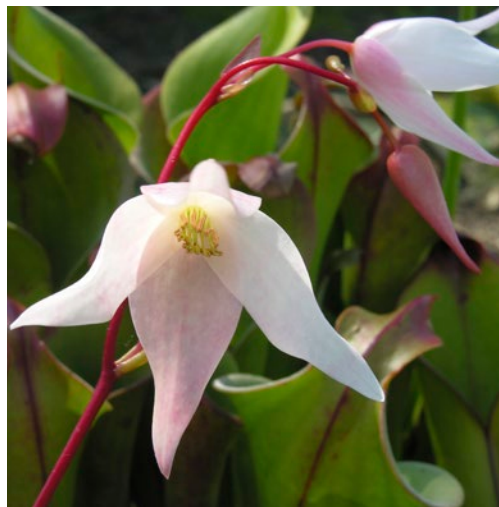
Leaves rise from a subterranean rhizome, which enables the plant to gradually divide and produce a clump. This can take a number of years—it is not uncommon for a single-crowned adult of some of the taller species to need a decade to become sizable.

In cultivation, sun pitchers flower in late winter through to early summer, and although



Species of *Heliamphora* together in the morning sun.

RIGHT The flower of *Heliamphora nutans*.



variable, they are of a similar structure. Each bloom is comprised of four white tepals, which surround the yellow stamens and stigma. They are pendulous, hanging downward in the same manner as other flowers in the family. The pure white tepals are held on tall, wiry stems which are either green or bright red, contrasting beautifully with the often colourful pitchers. With no petals to drop, the flowers last for three or four months, the tepals gradually darkening until the scape dies back. If pollination occurs, seeds are shed late summer. The flowers have an interesting mechanism to prevent self-pollination: pollen is shed prior to the ripening of the receptive stigma, and then only with the aid of the vibration from the pollinators' wings, which shake the anthers. In cultivation, it is best to remove a few of the stamens and split them open to access the pollen, transferring it to another flower with a green stigma.

CULTIVATION

Traditional literature has often stated that you should spray heliamphoras on a regular basis, but this is unnecessary and can even be detrimental by seemingly encouraging sooty mildew. I never spray my plants. I do, however, water them regularly from above, to



LEFT A large *Heliamphora nutans* ready to divide.

RIGHT Carefully remove the pot. Remember, all parts of these plants are very brittle.

ensure the pitchers are kept full—remember, where these plants are found it often rains every day, sometimes for days at a time. Understanding how a plant grows in the wild is key to its successful cultivation, and this fact is especially true with heliamphoras.

It is also a misconception that these plants do not like standing in water; some of the lower-growing plants can be flooded up to the level of their mouths for long periods of time. They all need to be kept wet to a depth of up to 3 in. (7½ cm) of rainwater in the growing season. Reduce the amount to keep them merely damp over the winter if they are in a greenhouse or on a windowsill.

Coming from an equatorial region, sun pitchers are adapted to very high light levels. This is particularly the case with species found atop the tepuis, where light intensity can be fierce and is exacerbated by the high altitude. Conversely, temperatures on the summit plateaus rarely exceed 77°F (25°C) during the day, and can plummet to as low as 37°F (3°C) at night. When one considers their natural habitat conditions, it's not surprising that *Heliamphora* plants in cultivation require intensely high light for optimal colouration. They are generally suited to Zone 11, tender to 40°F (4°C), and do not like overheating—temperatures over 86°F (30°C) are detrimental. The more commonly grown species will be fine on a sunny windowsill in your home. But in a greenhouse or conservatory, take care to keep the temperature down. A couple of suggestions in the greenhouse are to stand plants in the bed nearest the door to allow access to the



LEFT Divisions ready to be potted separately.



RIGHT Once plants are potted, keep them shaded and cool for a few weeks to aid re-establishment.

breeze, and also to soak them around the middle of the day if possible, giving them a good drenching. Wetting the floor thoroughly will also have a cooling effect as the water evaporates.

These plants make ideal candidates for the terrarium, where the temperature can be controlled a little more easily, especially if lit by cooler lights such as fluorescent tubes or LEDs. This environment makes it easy to provide sufficient illumination for good plant colour, and is also conducive to easy watering and ventilation. There are a number of species in the ideal 6 to 10 in. (15 to 25 cm) height range for terrariums.

Use a potting mix of equal parts peat moss and perlite. Provide good-sized containers so the plants can divide and clump. This will also mean less-frequent repotting—an important consideration, since all parts of the plant are unusually brittle and don't appreciate regular disturbance. Repot in the spring, when flowers are open, as this will allow time for the plants to recover sufficiently.

PROPAGATION

There are two options for propagating *Heliamphora*: seed and division. Seed is, alas, very slow but will result in a number of plants being produced. The seeds should be sown as soon as they are shed, which means late summer, or as soon as you receive them (in their

natural habitat the temperatures are fairly constant year-round). Seeds will appreciate the coolness of spring in which to germinate. Germination takes four to six weeks, and seeds should be sprayed a couple of times per day to replicate the wet season in their natural habitat. It has even been suggested that the growth inhibitors which prevent a seed from germinating at an inappropriate time require this flushing to disperse. Treat the seedlings as adult plants, but be aware that they are exceptionally susceptible to heat stress at this size.

Division is far more preferable, but take care because of the plants' delicate nature. This should be done in the spring. Tip the contents of the pitcher out and remove the plant by upending the pot, supporting the plant carefully. Remove as much of the loose potting mix as you can, before washing off the bulk of the remainder in a bucket of rain-water. This will allow you to see the structure of the plant and will make the division process easier. Either divide the plant into two or three pieces, or just remove a couple of growth points, ensuring that each has a few roots attached. Plant these in the standard potting mix, firming down gently, and thoroughly soak. Due to their delicate nature, it is common for the crowns to snap off without roots. Crowns can still be potted, burying the base of the plant 1 in. (2½ cm) into the soil, where they will root through in time. These must be kept shaded until they have rooted.

Plant Suggestions

Heliamphora heterodoxa

A species with wide distribution, found in Venezuela both high atop Ptari-tepui, and in lowland areas of the Gran Sabana (great savanna). *Heliamphora heterodoxa* is a variable plant to 10 in. (25 cm) in height, apple green, flushing red as the leaves age. The red-rimmed mouth holds aloft a red nectar spoon that can be broad and flattened, elongate and overhanging the mouth, even helmet-shaped. The white flowers, to 2 in. (5 cm) in length, are borne on long red stems to 24 in. (60 cm) high. Ideal for terrarium or greenhouse cultivation.



Pitchers of *Heliamphora heterodoxa*.



An insect's-eye view of *Heliamphora minor*.

RIGHT *Heliamphora nutans*.



Heliamphora minor

Heliamphora minor is the smallest species is found on Auyan-tepui, the mountain from which Angel Falls, the world's highest uninterrupted waterfall, flows. It produces pitchers to only 6 in. (15 cm) at their largest, usually smaller. It is a beautiful plant, with leaves opening a vibrant green and often touched with red veins that darken to a deep crimson, occasionally almost black, in intense sun. It is a dense, clump-forming plant which in the wild can be up to 39 in. (100 cm) across, with white nodding flowers to 1¼ in. (3 cm) long on red stems to 12 in. (30 cm) high. Ideal for terrarium or greenhouse cultivation.

Heliamphora nutans

The first species of *Heliamphora* to be discovered, *H. nutans* is generally considered to be the easiest to grow in cultivation—particularly tolerant and a good choice for first-time growers. It is found on several tepuis, and is typically up to 8 in. (20 cm) in height, the pitchers often producing flushes of pink-red in cultivation, darkening to solid red as they age or in good light. Elegant leaves contrast well in the spring with the white flowers, which are to 2 in. (5 cm) long and are held on bright red stems to 24 in. (60 cm) high. This species seems to be particularly tolerant in cultivation and is a good choice for first-time growers. Ideal for terrarium or greenhouse cultivation.



The large flower of *Heliamphora tatei*.

LEFT *Heliamphora tatei*.

Heliamphora tatei

I include *Heliamphora tatei*, a somewhat less-available plant, because it provides such a contrast to other species mentioned. It is harder to source, but seems to revel in the conditions favoured by other species. The tall fluted pitchers are typically a solid green colour, and are to a maximum height of 18 in. (45 cm), though usually a little smaller. It rarely produces the stem I spoke of earlier, and indeed this can take many years, suggesting that some fantastically old plants exist in the wild. Ideal for terrarium or greenhouse cultivation.

Nepenthes

TROPICAL PITCHER PLANT

On your knees for royalty! *Nepenthes* is regarded by many as the monarch among carnivorous plant genera. With their unique, unrivalled spectrum of form and size, these plants represent extremes of evolution.



From the left, three stages of pitcher development in *Nepenthes boschiana*.

RIGHT From left, the lower, intermediate, and upper pitchers of *Nepenthes boschiana*.



Tropical pitcher plants are found predominantly in Southeast Asia, with a few satellite species living as far afield as Madagascar and India. These are the stereotypical tropical jungle plants and are the sole genus in the family Nepenthaceae, which currently boasts around 150 species. This number continues to increase as more new species are identified by dedicated explorers—a fascinating fact, considering how few horticultural discoveries we assume are left in this twenty-first century.

Plants generally form a climbing stem from a terrestrial rosette. The stem is clothed in leaves, from which the midrib extends, producing a long tendril that flares out at its tip to form the pitcher. The mouth is surrounded by a slippery rim known as a peristome, which exudes nectar. This rim overhangs the interior of the trap, where digestive fluid is contained. There is a lid, which in many species acts as an effective barrier to prevent ingress and dilution of the pitcher fluid, though in other species, the lid is less effective.

There are two distinct types of pitcher. The lower pitchers, produced at ground level, nestle among mosses or leaf litter. They are joined to the tendril at the front of the pitcher, which is fringed along its length by two flanges. These flanges are edged with soft spines, perhaps as a guide for crawling prey in the same way as the *Cephalotus* pitcher. Lower pitchers range in size from the fingernail-small *Nepenthes argentii*, to the gargantuan *N. rajah* from Borneo. It is with these huge pitchers that some species of *Nepenthes* have evolved to become true carnivores, rather than the more limited insectivorous

nature of the other genera. Traps can be the size of an American football, and the largest single *Nepenthes* pitcher discovered held a volume of over 3½ quarts (3½ litres) of fluid. This is the only plant genus ever found to contain the remains of rats within its traps. The capture of vertebrates is not unusual with these plants, and frequent prey include frogs, lizards, and smaller rodents, as well as the usual insect fare.

Upper pitchers, as the name implies, are found higher up the stem, and they are formed when the plant begins to climb. These differ from lower pitchers in several ways: they are smaller, more funnel-shaped, and the tendrils attach at the rear, so the mouth is facing away and designed to attract flying insects. Tendrils in these upper leaves are also prehensile and will wrap and coil around surrounding vegetation for support.

The flanges are absent in these pitchers, reduced to a pair of ridges, and the climbing stems in the largest plants may scramble up to 50 ft. (15 m), though often less. Intermediate pitchers, which are midway between the two types, are occasionally formed.

The plants are dioecious, which means there are male and female individuals each producing slightly different, and somewhat innocuous, flowers—unique among carnivorous plants.

It is interesting to note that these plants are nearly always found as terrestrials, which then scramble and climb. There is a common assumption that they are all epiphytes, but in reality very few species of *Nepenthes* live in this manner.



Male flowers on *Nepenthes rajah*, in habitat on the island of Borneo.

CULTIVATION

Let's not beat about the bush. These can be large, climbing plants, a fact which can present problems in smaller spaces. I'm not going to lie—to grow *Nepenthes* plants truly successfully you really should invest in a separate greenhouse, both to accommodate the plants' growth tendencies, and to provide the environment they require. However, if a

greenhouse setup is not possible, don't dismiss the entire genus. There are a number of smaller-growing plants which are suitable for the terrarium.



A large and impressive setup, created by Jeremiah Harris, Colorado, United States.

For cultivation purposes, tropical pitcher plants are loosely divided into two groups: highland and lowland, which are differentiated mainly by temperature. The lowland plants are generally found at altitudes below 3280 ft. (1000 metres), and the highland plants are above this. The most important factor is temperature; this reduces with altitude and hence the plants become more tolerant of cooler conditions, an important consideration with regard to winter heating.

LOWLAND SPECIES These species are inhabitants of hot and humid environments, often shady and tropical rain forests, exactly as we might imagine. For the lowland plants, a winter minimum of 64°F (18°C) is ideal. Light is an important factor, with lowland plants often tolerant of shady conditions.

HIGHLAND SPECIES Highland plants prefer brighter conditions. However, as with *Heliamphora*, highland nepenthes plants do not like the excessively high temperatures which are often associated with brighter conditions in a greenhouse—but they do need good humidity, which in itself serves to cool the environment. If grown in a greenhouse, highland species are cheaper to heat due to their preference of lower temperatures; a minimum of 45°F (7°C) will suffice for many. The highland group also offers a much wider variety of plant choices than the lowland group, including some of the most interesting and attractive in the genus.

When they are small, my plants are grown in pond baskets, in a mix of equal parts coarse orchid bark and sphagnum moss. I move them to large, 2½- or 4-gallon (10- or 15-litre) containers once they are big enough. This may seem a little excessive, especially since they have comparatively fine root systems, but there is a reason: it reduces the frequency of necessary watering. *Nepenthes* also appreciates an open, airy mix in which to grow, and I favour equal parts coarse orchid bark and sphagnum moss. Again, this is a genus for which growers seem to develop their own preferred planting mix recipes, and you will soon realize there are many variations. Virtually all the species loathe standing in water, yet conversely must never dry out.

Thoroughly drench the potting mix every day in the summer, gauging this according to your plants' needs and the size of containers you are using. In hot weather, regular spraying of the plants with rainwater (using a hose) and dampening the floor several times a day will help regulate excess heat. These tasks are not easily undertaken if one works outside the home, and a little ingenuity may be required. You can install a few misting jets and a suitable pump (not as expensive as one might imagine) to avoid the worry of your plants frying. These can be combined with either a timer, or a humidistat set to around 85 percent. A layer of shade netting will also help regulate the temperature and allow the plants enough light to colour well. During the winter, watering can be reduced to as little as once a week, again depending on your specific conditions. You will soon get a feel for what is needed.

Being a tropical genus, *Nepenthes* grows year-round in the wild. But in cultivation, you will find with the cooler temperatures and lower light levels of winter that they tend to sit in a state of suspended animation. When early spring arrives, they resume the production of pitchers.

If a dedicated greenhouse is impractical, a terrarium is the best solution. There are some advantages to this cultivation method. The temperature and light (if artificial) can be maintained year-round, keeping the plants in growth. The daily maintenance and vital watering regimen required with a greenhouse will be drastically reduced in a smaller, more confined environment. And, the maintenance costs associated with a terrarium will be much less than the expense of running a greenhouse. Do keep an eye on the temperature and ensure it doesn't rise too high in hot weather—positioning the terrarium out of direct sun will prevent this. Highland species will require no extra heat if in the house, but low-land species may, to the temperatures mentioned previously. A degree of periodic maintenance will be necessary to keep terrarium-grown plants in control—they will happily plot their escape while your back is turned, and the climbing stems will begin to explore. When this happens, simply trim the stems back to a more manageable length.



A *Nepenthes mira* pitcher dying back at the end of its useful life.



A container of the hybrid *Nepenthes xmixta*, hanging outside for the summer in the author's garden, Somerset, England.

As with the majority of climbing plants, each leaf has at its base a dormant lateral bud which only commences growth if the stem above that point is damaged or removed, and the plant will regrow from this point. If you do prune, take care that the cut you make is on green stem—a cut on the brown, woody section is unlikely to regrow. You will also notice the presence of small rosettes forming at the base, which will occasionally produce new stems. Many plants will have several stems when they are mature, so removing one or two will do little harm to the plant.

There are a few horticultural hybrids of *Nepenthes* which can occasionally be found in garden centres.

These are often a little more tolerant of harsher conditions and are ideal candidates for a shady position within the greenhouse or conservatory, especially among other plants. If some heat is provided over the winter, they will happily thrive in this environment year-round. Water and spray daily, more frequently in hot weather.

Tropical pitcher plants can also be grown outside in the summer months (that was when I discovered my “bird-eating” specimen). Planted in large containers and hung from the branches of a tree, they make fascinating and unusual subjects for a tropical garden.

PROPAGATION

There are two methods of propagating species of *Nepenthes*: by seed and by cuttings. Seed is sometimes available and is a good method of raising a number of plants, but it has its drawbacks. It is slow—you will wait four to five years for a good-sized plant to be produced. The seeds also must be fresh, with what is probably the narrowest viability window of all carnivorous plants. In the case of *Nepenthes bicalcarata*, that window is as little as two to three weeks, so the seed needs to be sown immediately if it is to have any reasonable chance of germinating. Seed should be surface sown onto chopped sphagnum moss, and kept damp and in high humidity. This can be in a propagator or wherever



Splitting the ends of the cuttings can help rooting.

LEFT *Nepenthes* cuttings. Reduce the leaf length by half.

you are growing your adult plants. Good light is also important, but keep newly sown seed out of direct sun. Some bottom heat will also help. Germination can occur in as little as two to three weeks. Seedlings should be pricked out and placed into individual pots once they are large enough to handle, and treated as adult plants.

Cuttings are the most convenient method of increasing your stock, and these should be taken in the spring to allow new plants the whole season to develop. Because *Nepenthes* plants are keen to explore, there is likely to be an abundance of material from which to take cuttings; healthy, undamaged stems should be used. If the stem is short, simply remove the top section of perhaps four leaves plus the growing tip, cutting midway between two leaves. Cut each of the leaves with scissors to half their length; this will reduce the amount of water loss. Dip the bottom end of the cutting in rooting hormone powder as per the instructions. The most important requirement is high humidity, followed by good light. Cuttings should root if both these needs are met either in a propagator (some bottom heat will again help here), or preferably in the high humidity environment of your other plants. Cuttings will begin to root in a few weeks, and once established, the new plant will commence growth.

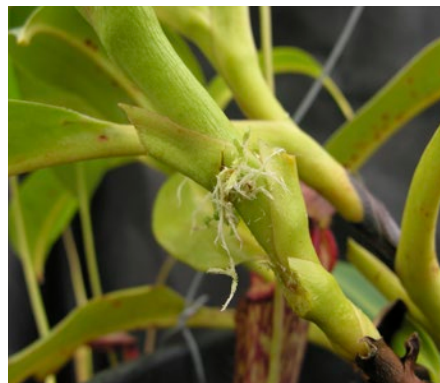
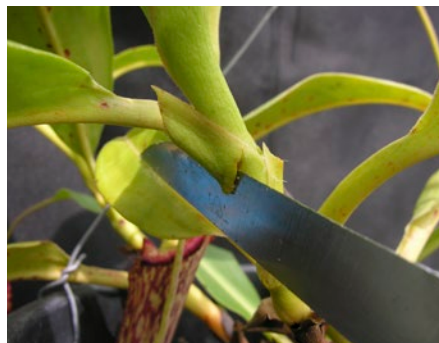
CLOCKWISE FROM
TOP LEFT:

Cut upward
through the leaf
node to a depth
that's about half of
the stem.

Insert a few
strands of
sphagnum into the
wound to keep it
open.

Wrap the wound
with more sphag-
num and enclose
in plastic.

Once rooted,
the stem can be
severed and the
cutting potted
and treated as the
adult plant. You
can see the black
fibrous roots on
the sphagnum.



Cuttings can also be taken from midsections of the stem. These will grow from the upper leaf node (remember the dormant lateral bud I mentioned previously). Be sure that the cuttings are taken from live, green sections of stem and not the lower, brown, woody section.

As another option, cuttings can be rooted in water. Simply stand them in 1 in. (2½ cm) of rainwater, and keep them in a bright location out of direct sun. A humid environment, such as a propagator, is ideal. To aid rooting, the lower 1 in. (2½ cm) can be split open, as one would a banana.

Air layering is another method of propagation—perhaps a preferable approach for rarer species, or for those which do not produce many stems. It is, in effect, taking a cutting from the plant without actually removing it from the adult. The cutting must be



taken from soft green stems. Begin by selecting a healthy, undamaged stem, and remove a leaf at the point at which you want roots to form. Using a clean-bladed knife, make a cut upward through the leaf node, to a depth of about one-half of the stem. Press a couple of strands of sphagnum moss into the cut to keep it open and to prevent the wound from resealing. You can add a little rooting powder at this point, although its effectiveness has been questioned with layering. Wrap a small quantity of sphagnum moss (about the size of a golf ball) around the wound. Use a cut-up plastic bag to hold the moss securely, tying the bag firmly at the bottom (though not too tight), and a little more loosely at the top to allow water to be added if the moss looks dry. After a few weeks, you will notice a number of black roots within the plastic; at this point the stem can be severed below them, and the plant potted and treated as an adult.

Plant Suggestions

Here I recommend a few plants that I feel are both easy and rewarding to grow. A closer look at the genus will open up a whole world of variation, which can quickly descend into the beginnings of true obsession. Don't say I didn't warn you.

LOWLAND SPECIES

Nepenthes albomarginata

Found in Borneo and Peninsular Malaysia, *Nepenthes albomarginata* is unique within the genus in that its pitchers have a white band underneath the mouth, comprised of many compressed white hairs. These hairs appear to be harvested by termites, which in the wild make up a large portion of the plant's captured prey. The lower pitchers are to around 3 in. (7 cm), the upper ones to 6 in. (15 cm) in height and variably coloured. An ideal plant for the greenhouse or terrarium.

Nepenthes ampullaria

This is the nepenthes with the widest distribution; it is found across Southeast Asia. *Nepenthes ampullaria* is a plant unlikely to be confused with any other, with its squat,

The upper pitcher
of *Nepenthes*
albomarginata in
habitat, Borneo.



The lower pitcher of *Nepenthes ampullaria* in Kuching, Sarawak, Malaysia.

oval pitchers. In the wild, these pitchers can form a dense carpet of open mouths, their narrow lids reflexed back. Without effective cover, the pitchers catch a large amount of debris falling from the trees above, and it has been suggested that the plant is adapting to derive nutriment from this leaf litter. Pitchers are up to 4 in. (10 cm) high, typically green and speckled in red, though various red forms exist. Upper pitchers are rarely produced and are small and functionless. *Nepenthes ampullaria* is good in a greenhouse situation where it can be allowed the space to develop and spread, and is also ideal for the terrarium. Grow this plant in pure peat moss, as it is often found in wet, swampy ground.



Nepenthes bicalcarata in habitat, Kuching, Sarawak, Malaysia.

RIGHT The delicate upper pitcher of *Nepenthes glabrata*.



Nepenthes bicalcarata

Another unique species from Borneo, *Nepenthes bicalcarata* bears traps which are furnished with two fang-like teeth that overhang the mouth. The lower pitchers are large—up to 10 in. (25 cm) in height, and can be voluminous, containing up to 1 quart (1 litre) of fluid. This is one of the biggest species of *Nepenthes*. If given free rein in a greenhouse, it will soon begin to wander, suspending its smaller-toothed upper traps in the air as it climbs. It is also suitable for the terrarium, though will need to be kept in check.

HIGHLAND SPECIES

Nepenthes glabrata

A native of the island of Sulawesi and a personal favourite of mine, *Nepenthes glabrata* has a dainty stature that makes it a perfect choice for the terrarium. If left to scramble, however (in a greenhouse, for example), it will soon reach the rafters. The lower pitchers are small, usually around 1 in. (2.5 cm) in height, coloured pale green with purple blotches

under a broad green peristome. Its tendrils can be surprisingly long and are produced from narrow, bright green leaves, themselves emerging from dark red stems. The upper pitchers are unusual in that they are often larger than their lower counterparts. They are a paler green, almost porcelain-like, with blood red markings. All in all, *N. glabrata* is a stunner.

Nepenthes mira

Found on the island of Palawan in the Philippines, beautiful *Nepenthes mira* produces brightly coloured, stocky pitchers to around 8 in. (20 cm) in height. The peristome surrounding the mouth is made up of many individual teeth, which hang over the liquid within.

Nepenthes rajah

Not the most practical of choices—and, due to its size, certainly not one for long-term success in the terrarium—*Nepenthes rajah* is nonetheless a truly remarkable plant. A native of two mountains on the island of Borneo (Tambuyukon and the famous Kinabalu), this species holds the distinction of bearing the largest traps in the genus. Its green and crimson pitchers can be up to nearly 16 in. (40 cm) high and 8 in. (20 cm) wide, giving them unsurpassed capacity. Due to their great size, *N. rajah* pitchers sit on the ground, a large convex lid overhanging the wide mouth. When plants produce climbing stems, they are rarely more than 6 ft. (2 m) in height. This is an ideal plant for the greenhouse; it enjoys good light and a potting mix of equal parts peat moss and lime-free sand. Keep it wet but do not stand it in water.

A word of warning, and a valuable lesson: I had carefully nurtured my plant, and it was producing pitchers to around half their adult size, when a faulty light tripped the power one frosty evening. I lost a number of rare *Nepenthes* specimens in one night. With expensive plants such as these, it is best to have a backup heater that will take over in such a scenario—gas is ideal.



The stocky pitcher of *Nepenthes mira*.

OPPOSITE *Nepenthes rajah* in Mesilau, Malaysia.





LEFT *Nepenthes ramispina*.



RIGHT *Nepenthes spathulata*.

Nepenthes ramispina

A beautiful species from Peninsular Malaysia, *Nepenthes ramispina* produces pitchers to 8 in. (20 cm) in height. Unique in colouration, they become purple-black in good sunlight. Good-sized traps are produced while the plant is still fairly small, making *N. ramispina* a good selection for the terrarium.

Nepenthes spathulata

Found on the island of Sumatra, *Nepenthes spathulata* is another favourite of mine that is vigorous and easy to grow. The fleshy, bright green leaves produce comparatively huge lower pitchers of a similar shade of green, with red-crimson peristomes. These can be up to 10 in. (25 cm) in height and can be formed while the plant is still young, making *N. spathulata* a good choice for the terrarium. It is also well suited to the greenhouse, where it can (and will) scramble to its heart's content.



*Nepenthes
truncata.*

Nepenthes truncata

I've listed *Nepenthes truncata* as a highland species, but it is found in wide altitudinal distribution on the island of Mindanao, in the Philippines, so both highland and lowland forms exist. It is a fantastic creature, producing some of the largest upper pitchers in the genus, frequently over 12 in. (30 cm) in height. They are of a red-green colour with wide and frilly orange-red peristomes.

CHILDREN, BEGINNERS & EDUCATION

L earning should be fun in every sense, so I'm not suggesting you make your children (or yourself) sit through dry experiments and exams; rather, you should use

these fascinating plants to introduce young people to the wider world of green, growing things. After all, to my mind, there is no group of plants quite as amazing as the carnivores.

Start kids young. Let them touch a Venus flytrap. It will grab their attention and do no long-term damage to the plant if the encounters are brief and occasional. Botany is seen as a dull subject, simply because plants do not move and operate in the same time frame we do. To avoid the continuing decline in interest, we need to snatch our children's developing minds away from electronic games and other distractions of the modern world, and encourage kids to become fascinated with the wonders of the natural environment.

Of course, children are not the only ones susceptible to the marvels of carnivorous plants, and I am happy to see increasing numbers of gardeners and hobbyists become infatuated. The following information is intended to help introduce curious minds of all ages to this captivating group of plants.

OBSERVING

These plants are great fun to watch, and simply observing their behaviour can facilitate discussion on trapping methods, effectiveness, adaptation and evolution, and methods of attraction.

Pitcher in a bottle

This activity requires a small receptacle that will hold water; a clear, 67-oz. (2-litre) plastic soft drink bottle with the label removed; a couple of flies of any variety; and an upright *Sarracenia* pitcher, freshly cut from one of your plants.

Begin by pouring roughly a cup of water into the bottom of the receptacle. Cut a hole a short distance from the end of the tube section of the pitcher, large enough for a fly to escape. Cut off the bottom section of the bottle, to form a bell shape. (If you are doing this with children, supervise or handle the cutting steps.) Place the pitcher in the water and position the bottle over it, leaving the lid on.

Lift the edge of the bottle and release a fly or two. It may help with handling the flies to first place them in the freezer for a couple of minutes (no more or they might die)—this will slow them down a bit. Once under the bottle cover, the flies will soon return to



Venus flytraps and their prey will always fascinate young gardeners.

normal activity. Watch carefully, as the flies are attracted to and subsequently caught by the pitcher. The hole you've cut in the pitcher will provide an escape hatch for the fly, but with luck, the process should repeat several times.

The same activity can be performed with full plants inside a standard propagator. Try *Dionaea muscipula* or a species of *Drosera*. However, without the escape hole, it will of course be "game over" for the flies.

Filmed traps in action

Plants in the genus *Pinguicula* move too slowly to be observed. Conversely, specimens of *Utricularia* move too quickly and are too small. The mechanisms of these carnivorous plants are best observed on film, and a quick Internet search will bring up ample opportunities to witness the plants' trapping sequences.

Growing carnivorous plants from seed

As we know, carnivorous plants can take a long time to germinate and grow to full size. To preserve any hope of keeping a child's interest alive (or that of many an adult), forget about growing Venus flytraps or pitcher plants, and instead choose plants that will develop faster. Some species of *Drosera*, most notably *D. capensis*, are easy to grow and do so relatively quickly.

Please, please avoid prepacked seed kits. The chances of seeds from these packages germinating are only slightly more than nil, and failure will likely only discourage would-be botanists, as well as further the prevalent view that carnivorous plants are hard to grow.

FURTHER INVESTIGATION

A small collection of carnivorous plants kept in a suitable location in a classroom can be a useful aid to all types of botanical education, for students of any age. For older students, there are a multitude of questions that can spur experiments and analysis. Use the following as prompts to initiate or enhance study.

VENUS FLYTRAPS

- How does temperature affect closure speed?
- How long do traps take to reopen with prey of different sizes?
- What effect do different fertilizers have?

SUNDEWS

- What is the smallest mass size of particle that can be detected?
- Do different species react with different speeds?
- What types of chemical solutions will facilitate a reaction?

SARRACENIA PITCHER PLANTS

- Does the volume of nectar produced vary between species?
- Does the application of UV light affect trap efficiency?
- Do some species drug their prey?



RESOURCES

Nurseries

The following nurseries specialize in carnivorous plants. They all have long-standing, sturdy reputations.

UK

Hampshire Carnivorous Plants
hantsflytrap.com

Hewitt-Cooper Carnivorous Plants
hccarnivorousplants.co.uk

South West Carnivorous Plants
littleshopofhorrors.co.uk

P & J Plants
pj-plants.co.uk

UNITED STATES

California Carnivores
californiacarnivores.com

EUROPE

Nature et Paysages
natureetpaysages.fr

Wistuba
wistuba.com

Best Carnivorous Plants
bestcarnivorousplants.net

Nepenthes glabrata,
upper pitcher.

Equipment

The following are a few equipment and sundries suppliers in the UK whom I know and would recommend. An Internet search in your respective country and/or region would undoubtedly bring up similar suppliers.

Two Wests
www.twowests.co.uk

This company has been trading for many years and supplies a wide range of high-quality equipment, not least of which is their exceedingly strong commercial benching, capable of holding the heavy load required. Custom work can be created to your specifications. They also supply heated trays and covers to your specification.

Waterside Nursery
www.watersidenursery.co.uk

Owned by my good friends Linda and Phil Smith, Waterside supplies not only water plants for your pond but also a selection of containers including the fibreglass mini pond shown on p. 67.

Metal Planters UK
www.metalplantersuk.co.uk

Manufacturers of galvanized and powder-coated plant troughs, which can be used for planting or as containers for holding pots. These are of superlative quality compared to most you see, and are available in myriad colours.

Societies

Societies are the perfect way to meet other like-minded individuals who share your interest. I feel it's important to make the effort to both join your local society and to attend their meetings. This is because as useful as the Internet is as a resource, it is still no replacement for meeting and talking to people who have shared the same successes and frustrations as you have. That said, the Internet may be very useful in helping you find societies in your area other than those listed here.

AUSTRALIA AND NEW ZEALAND

Australasian Carnivorous Plant Society
www.auscps.com

New Zealand Carnivorous Plant Society
www.nzcps.co.nz

BELGIUM

Drosera vzw
droseravzw.org

CZECH REPUBLIC

Darwiniana
darwiniana.cz

FRANCE

Association Francophone des Amateurs de Plantes Carnivores
dionee.org

GERMANY

Gesellschaft für Fleischfressende Pflanzen
carnivoren.org/gfp

ITALY

Associazione Italiana Piante Carnivore
aipcnet.it

JAPAN

Insectivorous Plant Society
ips.2-d.jp

NETHERLANDS

Carnivora
carnivora.nl

PORTUGAL

Associação Portuguesa de Plantas Carnívoras
appcarnivoras.org

SWEDEN

Scandinavian Carnivorous Plant Society
scps.se

UK

The Carnivorous Plant Society
thecps.org.uk

UNITED STATES

The International Carnivorous Plant Society
carnivorousplants.org

RECOMMENDED READING

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PHOTOGRAPHY CREDITS

Greg Allan, pages 67 left, 130 centre and right
Matt DeRhodes, pages 23, 61
NoahElhardt/wikimedia.org, page 95
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Plantsman **Nigel Hewitt-Cooper** has been fascinated by and immersed in the beautiful and strange world of carnivorous plants since he received a Venus flytrap from his uncle in 1981. By the late 1990s, his collection had grown to several hundred species and forms, and Nigel opened his own nursery. His plants have been awarded many accolades, including a number of Chelsea Flower Show gold medals. Nigel is a regular contributor to botanical journals and newsletters, has appeared on radio and television, and lectures on carnivorous plants.